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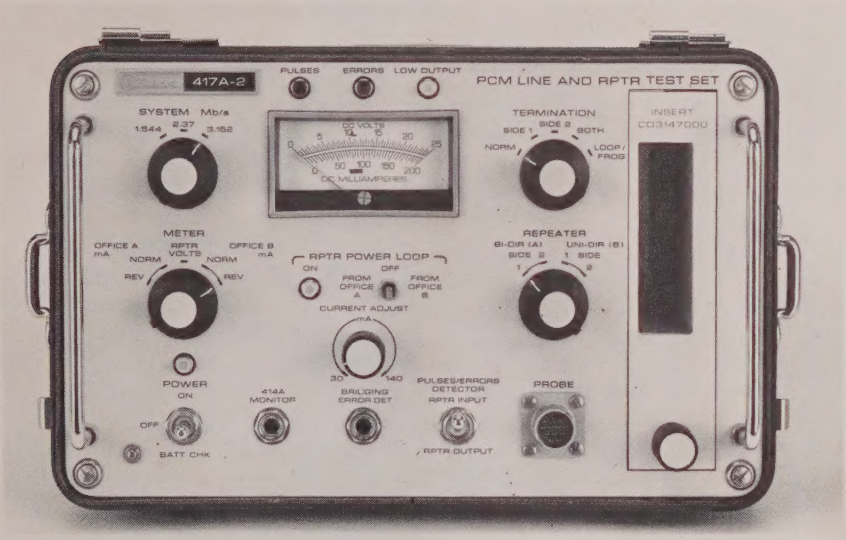

LSI/Sierra 417A-2 PCM Line and Repeater Test Set

This Maintenance Manual provides information for service and calibration center use. It is suggested that the instrument be calibrated on an annual basis, depending upon conditions and user requirements.

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TABLE OF CONTENTS

1. FUNCTIONAL DESCRIPTION 1
   - Inputs 1
   - Signal Switching 1
   - Meter 2
   - Block Diagram 3
   - Low Output Detector 4
   - Power Supply 4

2. CALIBRATION 5
   - Recommended Test Equipment 5
   - Internal Access 6
   - Power Supply/Meter Zero 6
   - Repeater Current/Voltmeter 6
   - Signal Flow and Continuity/Repeater Input and Output/ALBO Equalization 7
   - Pulse/Error Detector and High Level Bridging 9
   - Repeater Current/Voltmeter Calibration 10
   - ALBO Equalization 10
   - ALBO Regenerated Clock 11
   - No Data (No Pulses) Detector 13
   - Low Output Detector 14
   - Power Loop Regulator 15

3. TECHNICAL DATA 17
   - Specifications 17
   - Ordering Information 18

4. SCHEMATICS AND PARTS LISTS 19

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1. FUNCTIONAL DESCRIPTION

1.01 The Sierra 417A-2 consists of the following sections: Inputs (either direct or via special probe and insert); Signal Switching (sets up various test conditions); Universal Automatic Line Build-Out (ALBO) repeater; Pulses/Errors Detector; Power Looping Circuit; Meter; Low Output Detector; and Power (battery) Supply.

INPUTS

1.02 The simplest input circuit is the high impedance BRIDGING INPUT jack. It connects directly to an internal Automatic Build Out Repeater which regenerates the incoming PCM signal. The output of the Repeater drives the Pulses/Errors Detector. The SYSTEM Mb/s Selector Switch conditions the set for proper system bit rate. The Pulses Detector indicates presence of PCM pulses. The ERRORS detector is activated only by a Bipolar Violation (BPV), i.e., any pulse which is identical in polarity to the pulse that preceded it. (Bipolar signals should reverse polarity.) Note that bit rates other than the one the SYSTEM Selector Switch is set for are also considered errors. The 417A-2 is designed to recognize and ignore "built-in" bipolar violations in the T148 system (2.37 Mb/s) ONLY. BPV generated T1 or T1C will cause the ERRORS lamp to flash.

1.03 Another output from the internal Repeater drives the 414A MONITOR jack. The regenerated signal is available for extended error analysis by a Sierra 414A Error Counter if desired.

1.04 One of the most useful features of the 417A-2 is its ability to connect into and "take command" of all lines arriving and leaving a given PCM Repeater. This is accomplished by first removing the repeater under test, placing it in a special insert in the 417A-2, and attaching a multi-contact PROBE from the 417A-2 into the housing previously occupied by the PCM repeater. All lines associated with one repeater are now brought into the 417A-2 and the PCM repeater previously inserted.

SIGNAL SWITCHING

1.05 By utilizing the TERMINATION, REPEATER and PULSES/ERRORS DETECTOR switches, the Signal Switching circuit makes extensive changes in the lines for test purposes. In addition, the simplex repeater power feed is available for testing.

1.06 The REPEATER switch is operated according to the type of PCM repeater under test (Bi-Directional or Uni-Directional) and determines which of the two sides of the repeater will be monitored. A typical line repeater consists of two separate regenerators. A Bi-Directional regenerator pair handles both directions of a PCM system (usually one-cable operation); a Uni-Directional regenerator pair accommodates a single direction of two separate PCM systems (two-cable or screen-cable operation).

1.07 The Pulses/Errors switch selects either the Input or the Output of the PCM Repeater for monitoring by the internal ALBO repeater and Pulses Error Detector.

1.08 The TERMINATION Selector Switch performs further line conditioning. It can terminate the output of either repeater "side" in its proper impedance, or terminate both output sides at the same time. These terminations help in testing for effects of faults on the line. The LOOP/FROG position of the TERMINATION Switch reverses the output lines. In the case of a Bi-Directional repeater, this causes each side to be looped back to its originating office. A signal from Office A will be returned to Office A; a signal from Office B will, at the same time, be returned to Office B. In the case of a Uni-Directional repeater, a Frogging action occurs wherein the outputs continue toward the distant office, but on swapped facilities. Looping/Frogging methods are helpful in isolating troubles to a line section or repeater.

METER

1.09 The Meter circuit provides voltage readings across the PCM repeater under test. Voltage drop is determined by the manufacturer. Significant difference in voltage could identify a bad repeater or power distribution circuit. Power current is also measured. A typical PCM system is powered by DC current superimposed (simplexed) onto the two line pairs; one pair delivers current and the other pair returns current. Each repeater drops a portion of the applied voltage. A typical system may be powered from both ends; Office A powers out to a certain point and Office B powers out to this point. One repeater location therefore becomes a "Loop-Loop" (L-L)* point. While only one power feed is required for the repeater, experience has shown that current should be applied to all parts of all lines to minimize chance of open or high resistance circuits, particularly through jackfields.

1.10 The Meter will also display the 417A internal battery voltage under load conditions when the BATT CHK switch is activated.

1.11 The 417A can measure ***both*** Office A and Office B line currents if it is located at a Looping repeater point. Simply switch the METER selector from Office A to Office B, or vice versa. Provision is made for reading REVERSED power current in the event the power circuit is wired opposite to the normal method.

1.12 The simplexed power circuit passes only through the RPTR POWER LOOP-OFFICE A/OFFICE B switch when this switch is OFF. If power current is open, or of improper value, the technician can loop the power circuit back toward either Office A or Office B, depending on which office is supplying the power. (This is not operable at an L-L point where the power is normally looped.) When the switch is thrown toward the proper direction, power current passes through the Internal Regulator which limits current under control of the CURRENT ADJUST knob. The technician should avoid too much current flow by pre-setting the CURRENT ADJUST control to its lowest value (30 mA) before switching. The Power Loop "ON" lamp lights when the Power Loop is activated. Current can then be raised to normal value for that line.

NOTE: The power loop regulator operates over a voltage range of 15 to 300 Volts, measured directly across the regulator. A thermal cutout circuit protects the unit from potential damage caused by long term operation in a "worst case" condition (example: at the first repeater location in a long string of 140 mA repeaters). The regulator will operate for a minimum of 5 minutes at room temperature under maximum load of 140 mA at 300 Volts. Thereafter, the thermal cutout will operate. It is expected that "worst case" conditions will not often be encountered in the average testing situation.

*Loop-Loop (L-L) refers to the double looping of power current at the L-L point, i.e., Office A side is looped and Office B side is looped. Contrasts with T-T or "Through-Through" configuration.

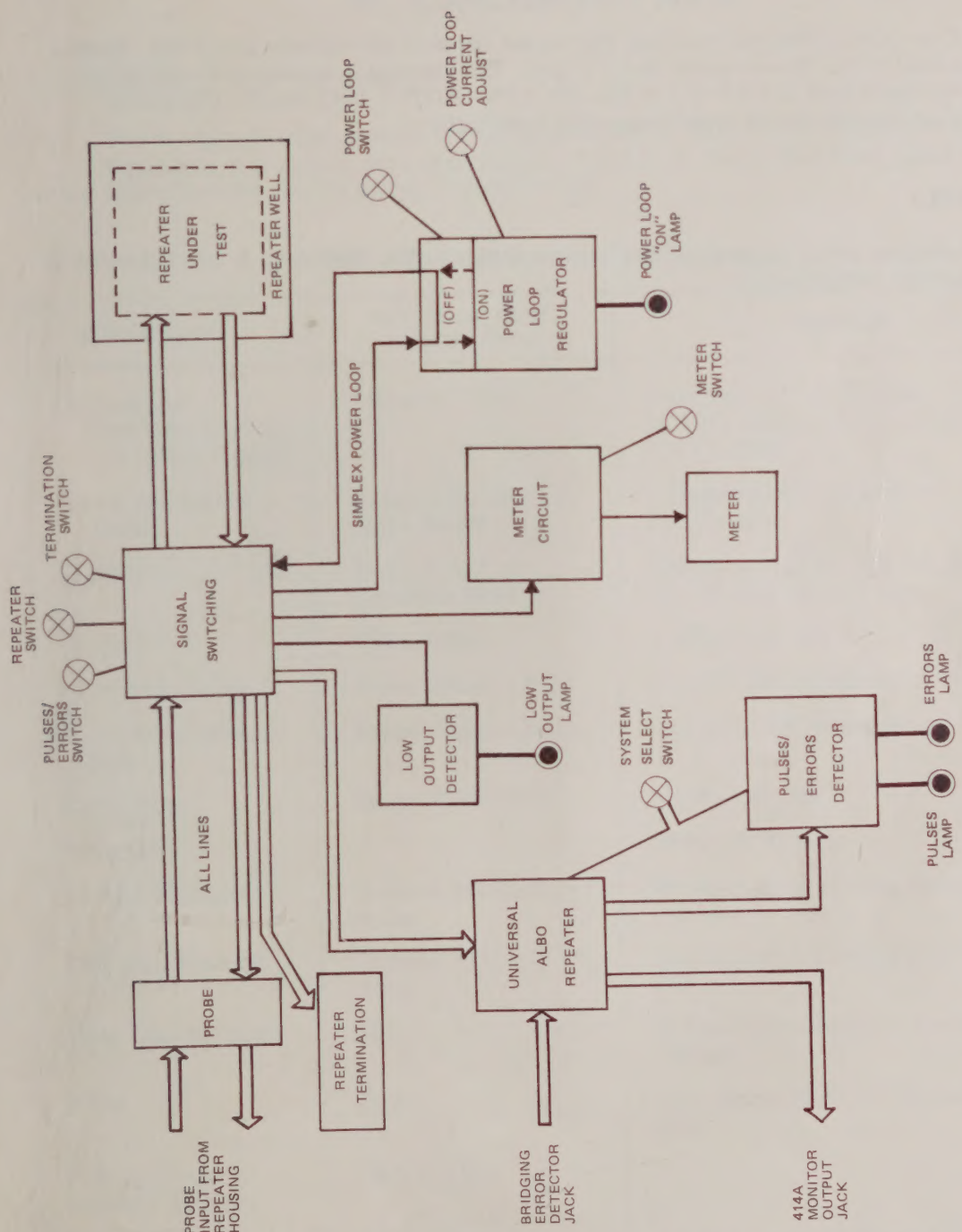


Figure 1-1. Functional Block Diagram

LOW OUTPUT DETECTOR

1.13 The Low Output Detector monitors the output signal of the repeater under test. Normal signal level of the bipolar pulses is 6.0 V p-p. The detector is inactive until signals are present. If the signal level is 4.8 V p-p or less, the LOW OUTPUT lamp lights. This pre-set alarm level is significantly below typical operating specifications.

POWER SUPPLY

1.14 DC operating power is supplied by 8 internal D-size carbon batteries. A fuse is located in the battery compartment.

2. CALIBRATION

RECOMMENDED TEST EQUIPMENT

2.01 Test equipment recommended for maintenance of the Sierra 417A-2 is listed in Table 2-1. Equivalent instruments, with characteristics equal to or better than those listed, may be used in lieu of specific models or types recommended.

Table 2-1. Recommended Test Equipment

DESCRIPTION	MODEL OR PART DESIGNATION	COMMENT
Oscilloscope Time Base Plug-In Vert. Amp. Plug-In	Tektronix 7603	Dual trace A + B function 50 MHz bandwidth or greater, X 10 probes
Digital Multimeter (DMM)	Dana 3300, 4300 or Fluke 8000A	1 Megohm input or greater, 1% accuracy
Synthesizer	Fluke 6011A or Rockland 5100	800 Hz to 4 MHz, 500 mV to 5V, 1% distortion or less
Counter	Fluke 1900A	2 MHz or greater
DC Power Supply	Power Design TP325	0 to 30 VDC at minimum of 0.5A
High Voltage Power Supply	Power Design 3K10B	0 to 300 VDC minimum
Patch Cord	Sierra 916400037	310-to-310 plug
Patch Cord		BNC-to-BNC plug
T1 Line Repeater	Lenkurt 91080/91083 series	Bi-Directional, Looping Power Mode, 140 mA
T1C Line Repeater	Lenkurt 91110/91111 series	Bi-Directional, Looping Power Mode, 140 mA
T148 Line Repeater	ITT	Bi-Directional, Looping Power Mode, 140 mA
Probe	Sierra	Appropriate Probe for Repeater Used
PCM Span and Repeater Test Set	Sierra 415A-2	
Extender Board	Sierra TF00233	A3 PCB Extender Board (see paragraph 2.09)

INTERNAL ACCESS

2.02 For access to internal parts of the 417A-2 and to various test points on PCB's, remove the instrument from its metal case as follows:

Step 1: Remove case carrying cover and verify POWER switch is in OFF position. If AC power cord connected, disconnect.

Step 2: Loosen four quick-connect screws on front panel.

Step 3: Carefully lift test set vertically by chromeplated bails until it clears case.

Step 4: Disconnect battery cable, removing plastic fuse case from holder clip.

WARNING

WHEN TEST SET IS REMOVED FROM CASE AND POWERED ON, POTENTIALLY HAZARDOUS VOLTAGES ARE PRESENT: THEREFORE, APPROPRIATE SAFETY PRECAUTIONS MUST BE PRACTICED AT ALL TIMES WHILE WORKING ON OR AROUND EXPOSED CIRCUITS AND CONNECTORS.

NOTE: Before beginning the following procedures, permit all test equipment to warm up for a minimum of 30 minutes.

POWER SUPPLY/METER ZERO

2.03 This procedure should be performed before proceeding to the other test and calibration sections. To adjust the 417A-2 Meter Zero and power supply, proceed as follows:

Step 1: With 417A-2 POWER switch OFF, adjust Meter Zero (located on Meter Window) so that Meter reads 0 VDC exactly.

Step 2: Remove batteries from Battery Compartment and connect external power supply to Batt (+) (Red lead) and Batt (-) (Black lead).

Step 3: Set external power supply to +9 VDC.

Step 4: Depress 417A-2 POWER switch to BATT CHK and if necessary adjust A4 Board R10 so that Meter needle is at left edge of "Green" zone.

REPEATER CURRENT/VOLTMETER

2.04 This procedure tests the 417A-4 Repeater Current and Voltmeter circuits, and tests for high voltage leaks. Connect 417A-2 to 415A-2 as follows:

NOTE: Since a Sierra 415A is used to calibrate the 417A, be sure the 415A is properly calibrated before calibrations are made on the 417A.

Step 1: Insert T1 Repeater into 417A Repeater Well. (A 140 mA Bidirectional T1 Repeater is recommended so that maximum meter deflection is achieved for calibration.)

Step 2: Insert appropriate probe into 415A repeater well and connect probe cable to 417A PROBE jack.

Step 3: Set both 415A and 417A SYSTEM Mb/s for 1.544 (T1).

Step 4: Depress HV TEST button on 415A. 415A HV LEAK lamp should not illuminate. If lamp illuminates, 417A has a dielectric leakage which will cause unit to operate improperly.

Step 5: Set 415A CURRENT ADJ pot CCW.

Step 6: Set 417A RPTR POWER LOOP switch to OFF.

Step 7: Set 417A METER switch to OFFICE A mA NORM.

Step 8: Set 415A CURRENT ADJ pot to recommended repeater current (see MFG specs). 417A meter should agree with 415A meter. If meters do not agree, see Repeater Current/Voltmeter Calibration Procedure.

Step 9: Set 417A METER switch to OFFICE B mA NORM. 417A meter should agree with 415A meter. If meters do not agree, see Repeater Current Voltmeter Calibration procedure.

Step 10: Set 417A and 415A to read REPEATER VOLTS. 417A meter should agree with 415A meter. If meters do not agree, see Repeater Volts section of Repeater Current/ Voltmeter Calibration procedure.

SIGNAL FLOW AND CONTINUITY/REPEATER INPUT AND OUTPUT/ALBO EQUALIZATION

2.05 This procedure tests the following: Signal Flow and Continuity, Repeater Input and Output Circuitry, and the ALBO. Using the same set-up from the previous section, perform the following:

Step 1: Set 415A as follows:

a. FUNCTION to QRSS.
b. STOP XMT/NORM/XMT ERRORS to NORM.
c. PULSE PERIOD to REF.
d. REPEATER TEST to BI-DIR (A) SIDE 1.
e. ART LINE dB to 5.
f. INTERFERENCE MARGIN dB to OFF.

Step 2: Verify 415A PULSES lamp will be either illuminated or extinguished according to the 415A and 417A switch positions given in Table 2-2.

Table 2-2. Switch/Lamp Conditions

417A			415A	417A	415A	417A
PULSES/ERRORS DETECTOR	TERMINATION	REPEATER	REPEATER TEST	PULSES LAMP	PULSES LAMP	ERRORS LAMP
RPTR INPUT	NORM	BI-DIR (A) SIDE 1	BI-DIR (A) SIDE 1	ON	ON	OFF
	SIDE 1			ON	OFF	
	SIDE 2			ON	ON	
	BOTH			ON	OFF	
	LOOP			ON	ON	
	LOOP	BI-DIR (A) SIDE 2	BI-DIR (A) SIDE 2	ON	ON	
	BOTH			ON	OFF	
	SIDE 2			ON	OFF	
	SIDE 1			ON	ON	
	NORM			ON	ON	
RPTR OUTPUT				ON	ON	

Step 3: Set 417A P/E DET to RPTR INPUT, TERMINATION to NORM, and REPEATER to BI-DIR (A) SIDE 1.

Step 4: Set 415A REPEATER TEST to BI-DIR (A) SIDE 1 and ART LINE dB to 36. 417A PULSES lamp should be illuminated and ERRORS lamp extinguished. If both lamp conditions are not achieved, see ALBO REGENERATED CLOCK calibration procedure.

Step 5: Set 415A ART LINE dB to 33 and verify 417A PULSES lamp illuminated and ERRORS lamp extinguished for 2.37 Mb/s (T148) and 3.152 Mb/s (T1C) using the appropriate repeaters, repeater current, and SYSTEM switch positions.

PULSE/ERROR DETECTOR AND HIGH LEVEL BRIDGING

2.06 High Level Bridging tests are incorporated into the Pulse/Error Detector test procedure. Perform the following:

Step 1: Connect a 310-to-310 cable from 415A GEN MON jack to 417A BRIDGING ERROR DET jack.

Step 2: Set 415A as follows:

a. POWER ON
b. FUNCTION to QRSS
c. STOP XMT/NORM/XMT ERRORS to NORM
d. PULSE PERIOD to REF
e. SYSTEM Mb/s to 1.544 (T1)

Step 3: Set 417A as follows:

a. SYSTEM Mb/s to 1.544 (T1)
b. RPTR POWER LOOP to OFF
c. TERMINATION to NORM

Step 4: Verify 417A PULSES lamp is illuminated and ERRORS lamp extinguished.

Step 5: Momentarily turn 415A POWER OFF. 417A PULSES lamp and ERRORS lamp should both be extinguished. 417A PULSES lamp should reilluminate and ERRORS lamp should remain extinguished when 415A Power is turned back on.

Step 6: Set 415A STOP XMT/NORM/XMT ERRORS to XMT ERRORS. 417A ERRORS lamp should flash and PULSES lamp should be illuminated.

Step 7: Repeat the above procedures for 2.37 (T148) and 3.152 (T1C) systems and verify appropriate 417A lamp conditions.

REPEATER CURRENT/VOLTMETER CALIBRATION

2.07 To calibrate the 417A-2 Repeater Current and Repeater Voltmeter, connect 417A-2 to 415A-2 as follows:

Step 1: Insert T1 Repeater into 417A repeater well. (A 140 mA Bi-directional T1 Repeater is recommended so that maximum meter deflection is achieved for calibration.)

Step 2: Insert appropriate probe into 415A repeater well and connect probe cable to 417A PROBE jack.

Step 3: Set both 415A and 417A SYSTEM Mb/s for 1.544 (T1).

Step 4: Set 415A CURRENT ADJ pot CCW.

Step 5: Set 417A RPTR POWER LOOP switch to OFF.

Step 6: Set 417A METER switch to OFFICE A mA NORM.

Step 7: Set 415A CURRENT ADJ pot to recommended repeater current (see MFG specs). 417A meter should agree with 415A meter. If not, adjust 417A A4 Board R7 so that meters agree.

Step 8: Set 417A METER switch to OFFICE B mA NORM. 417A meter should agree with 415A meter. If not, adjust 417A A4 Board R9 so that meters agree.

Step 9: Set 417A and 415A to read REPEATER VOLTS. 417A meter should agree with 415A meter. If not, adjust 417A A4 Board R14 so that meters agree.

ALBO EQUALIZATION

2.08 To adjust the ALBO Equalizer Gain, connect 417A-2 to 415A-2 as follows:

Step 1: Insert a T1 Bi-Directional Repeater into 417A repeater well and insert appropriate probe into 415A repeater well. Connect probe cable to 417A PROBE jack and set both 417A and 415A for 1.544 Mb/s (T1) systems.

Step 2: Set 417A METER switch to OFFICE A mA x 10 and adjust 415A CURRENT ADJ pot so that proper repeater current is obtained (see MFG. specifications).

Step 3: Set 415A as follows:

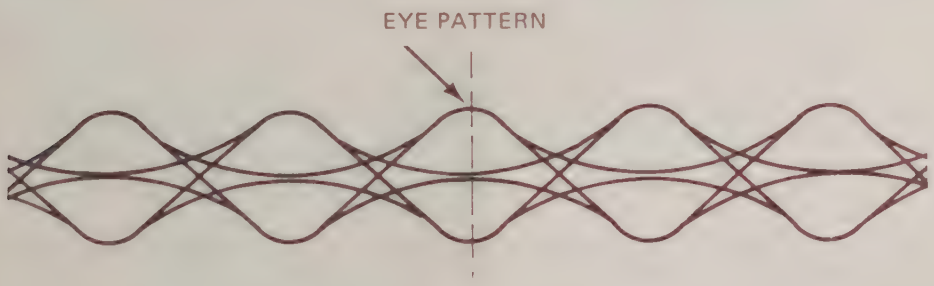
a. FUNCTION to 1111
b. STOP XMT/NORM/XMT ERRORS to NORM
c. PULSE PERIOD to REF
d. REPEATER TEST to BI-DIR (A) SIDE 1
e. ART LINE dB to 24
f. INTERFERENCE MARGIN dB to OFF

Step 4: Set 417A as follows:

a. RPTR POWER LOOP to OFF
b. TERMINATION to NORM
c. REPEATER to BI-DIR (A) SIDE 1
d. PULSES/ERRORS DETECTOR to RPTR INPUT

Step 5: Connect scope to 417A-2 A2A Board TP1 via X10 probe with its pigtail fastened to A2A Board TP GND.

Step 6: Adjust 417A-2 A2A Board R26 for the most open "EYE PATTERN" (on scope) as illustrated:



ALBO Calibration Waveform

ALBO REGENERATED CLOCK

2.09 To calibrate the ALBO Regenerated Clock, perform the following:

Step 1: Set SYSTEM Mb/s switch for 1.544.

Step 2: With 417A-2 power off, place A2A Board on A2A extender card into the 417A-2 chassis.

Step 3: Connect scope to 417A-2 A3 Board R25 left end (using X10 probe with its pigtail (ground) connected to A3 Board TP GND) and set scope vertical gain to maximum sensitivity.

Step 4: Connect a BNC-to-BNC cable from scope "vertical output jack" (on back of scope) to frequency counter input jack. If scope does not have "vertical output jack", connect frequency counter directly to A3 Board R25 left end using a X10 probe (thus bypassing the scope completely).

Step 5: Short circuit A2A Board TP3 to TP4 with shortest possible jumper.

NOTE: Do not remove the A2A shields when calibrating or testing.

Step 6: Turn POWER switch ON and adjust A2A Board C34 for a counter reading of 1.544 MHz ±5.0 kHz.

Step 7: Vary external D.C. power supply to 9, 10, and 12 VDC. Frequency counter should read 1.544 MHz for the three DC values. If not, then compromise by adjusting C34 so that counter reads approximately midway between high and low frequency extremes of the three DC values. Return ext. DC power supply to +10 VDC.

NOTE: DO NOT READJUST C34 AFTER THIS STEP.

Step 8: Turn 417A POWER off and remove jumper short between A2A Board TP3 and TP4.

NOTE: Some earlier models of the 417A-2 do not have an R90 "Trimpot" on the A2A Board. If test set has no R90, then leave jumper short connected between TP3 and TP4 and set SYSTEM Mb/s switch to 3.152 (T1C). Adjust R77 for 3.152 MHz ±5.0 kHz. Turn 417A power off and remove jumper short between TP3 and TP4. Remove A2A Board from extender card and place A2A Board back into original location. Turn 417A Power on (at +10 VDC) and return 417A SYSTEM Mb/s switch to 1.544 (T1). Then adjust A2A Board R74 for a counter indication of 1.544 MHz ±5.0 kHz. Disregard steps 9 through 12 and proceed with step 13.

Step 9: Remove A2A Board from extender card and place A2A Board back into original location in chassis.

Step 10: With external power supply set for +10 VDC turn 417A Power on and adjust A2A Board R74 for a counter indication of 1.544 MHz ±5.0 kHz.

Step 11: Set 417A SYSTEM Mb/s switch for 3.152 (T1C) and adjust A2A Board R77 for a counter indication of 3.152 MHz ±5.0 kHz.

Step 12: Set 417A SYSTEM Mb/s switch for 2.37 (T148) and, if necessary, adjust A2A Board R90 for a counter indication of 2.37 MHz ±25.0 kHz.

Step 13: For ALBO Regenerated Clock "In-Lock" check, set 417A switches as follows:

a. Power ON
b. SYSTEM Mb/s to 1.544 (T1)
c. RPTR POWER LOOP to OFF
d. TERMINATION to NORM
e. REPEATER to BI-DIR (A) SIDE 1
f. PULSES/ERRORS DETECTOR to RPTR INPUT

Step 14: Set 415A switches as follows:

a. POWER ON
b. FUNCTION to QRSS
c. STOP XMT/NORM/XMT ERRORS to NORM
d. PULSE PERIOD to REF
e. INTERFERENCE MARGIN dB to OFF
f. SYSTEM Mb/s to 1.544 (T1).

Step 15: Connect a 310-to-310 cable from 415A GEN MON jack to 417A BRIDGING ERROR DET jack.

Step 16: Verify 417A PULSES lamp is illuminated and ERRORS lamp is extinguished. If ERRORS lamp flashes or is illuminated steadily, adjust 417A A2A Board R26 until ERRORS lamp extinguishes ("no errors" indication).

Step 17: Vary 417A external DC power supply between 9, 10, and 12 VDC and verify that counter shows an "In-Lock" reading of 1.544 MHz. 417A Pulses lamp stays illuminated and ERRORS lamp remains illuminated for each of the three voltage settings. If these conditions are not met, adjust 417A A2A Board R74 for an "In-Lock" counter reading of 1.544 MHz and adjust R26 for "no errors" indication.

Step 18: Return 417A external DC power supply to +10 VDC.

Step 19: Momentarily turn off 415A-2 and verify counter frequency drifts away from 1.544 MHz ±78 kHz. 417A PULSES and ERRORS lamps should be extinguished. 417A PULSES lamp should reilluminate and ERRORS lamp should remain extinguished when 415A power is turned back on.

Step 20: With 415A and 417A Power ON, momentarily depress 415A XMT ERRORS and verify 417A ERRORS lamp flashes. Verify 417A ERRORS lamp extinguishes when 415A XMT ERRORS/NORM/STOP XMT switch is returned to NORM.

Step 21: Set 415A and 417A for 3.152 Mb/s (T1C) and verify "In-Lock" counter frequency of 3.152 MHz ±158 Hz for external DC power supply voltages of 9, 10, and 12 VDC. If "In-Lock" condition is not met for the three DC voltages, adjust 417A A2A Board R77 so that counter reads "In-Lock" condition of 3.152 MHz ±158 Hz.

Step 22: Return 417A external power supply to +10 VDC.

Step 23: Repeat steps 19 and 20 for 3.152 MHz ±158 Hz.

Step 24: **Set 415A and 417A for 2.37 Mb/s (T148) and verify "In-Lock" counter reading of 2.37 MHz ±119 Hz for external DC power supply voltages of 9, 10, and 12 VDC. If "In-Lock" condition is not met for the three voltage settings, adjust 417A A2A Board R90 so that counter reads "In-Lock" condition of 2.37 MHz ±119 Hz.

Step 25: **Return 417A external power supply to +10 VDC and repeat steps 19 and 20 for 2.37 MHz ±119 Hz.

NO DATA (NO PULSES) DETECTOR

2.10 To calibrate the PULSES Detector circuit, proceed as follows:

Step 1: Connect DMM to 417A A2B Board TP2 (+ Volts) and TP1 (Common).

Step 2: With 417A Power ON, DMM should read approximately -40 mVDC across TP2 and TP1. If not, adjust A2B Board R22 so that desired DMM value is obtained.

** Omit steps if set has no R90 on A2A Board.

LOW OUTPUT DETECTOR

2.11 The low output detector circuit is preset at the factory to cause the Low Output lamp to light if repeater output falls to 5.0 V p-p or less. Field adjustment can be made to raise or lower the threshold if desired.

Step 1: Refer to Fig. 2-1. Set the Sine Wave Generator (1) to 772 kHz. Set output level to desired range. Attach test cords to the "B" test points on the 417A-2 Probe (2). ("B" test points normally monitor Side 1 Output cable pair.)

Step 2: Attach Oscilloscope (3) and adjust output of the Sine Wave Generator to the peak-to-peak voltage which represents the desired low-level threshold as shown on the scope.

Step 3: Set REPEATER switch (4) on the 417A-2 to "Bi-Dir, Side 1." Locate the threshold potentiometer (5) at the rear top edge of PC board A2B.

Step 4: Adjust the potentiometer until the LOW OUTPUT lamp (6) just lights. The 417A-2 is now calibrated to activate the LOW OUTPUT lamp when repeater output falls to the new threshold level or below.

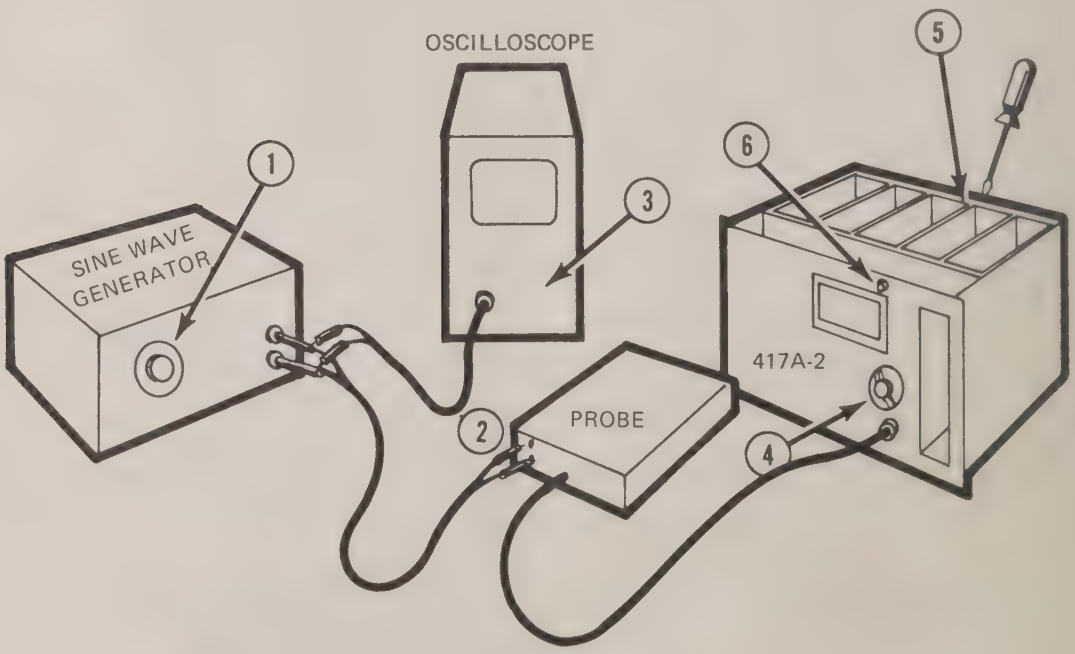


Figure 2-1. Field Adjustment of Low Output Threshold Potentiometer

POWER LOOP REGULATOR

2.12 To facilitate application of an external power source for the Power Loop Regulator, use a 417A-2 Probe assembly with cover for repeater end of probe removed. Repeater Volts may also be verified using this probe assembly.

Step 1: Remove cover from repeater end of probe so that Power Loop connection may be made. Connect probe cable to 417A PROBE jack.

Step 2: Insert a 140 mA T1 Line Repeater into 417A-2 Repeater Well.

Step 3: Set METER switch to OFFICE A mA NORM.

Step 4: Set RPTR POWER LOOP switch to FROM OFFICE A and turn CURRENT ADJUST pot full counterclockwise.

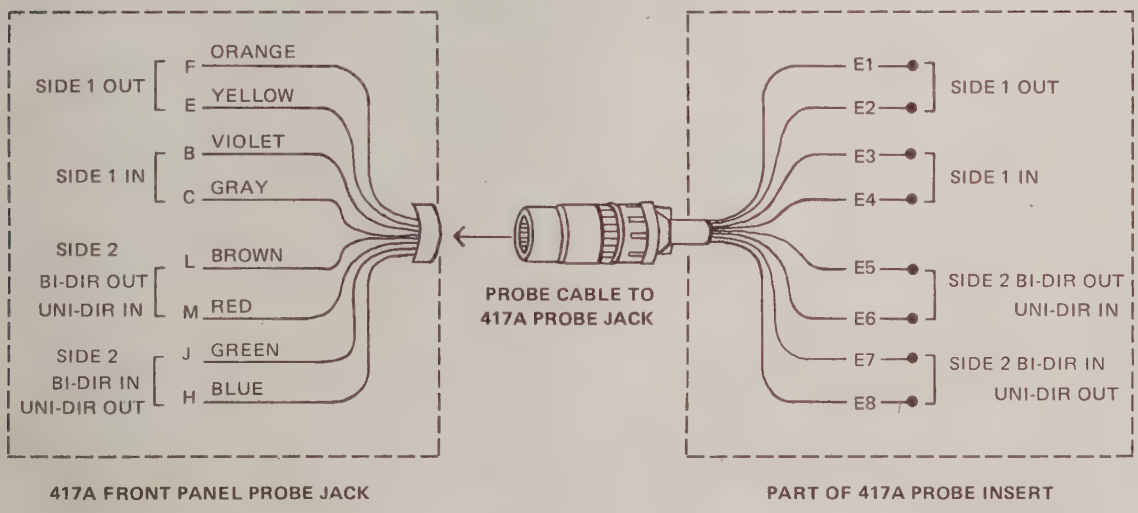


Figure 2-2. 417A-2 Probe-to-Power Loop Regulator Connections

Step 5: Short together pins E3 and E4 (SIDE 1 IN) of Probe PCB (see Figure 2-2) and connect to + Volts of external power supply.

NOTE: Use alligator-to-alligator clip type cords to connect necessary shorts. Do not solder pin connectors.

Step 6: Short together pins E5 and E6 (SIDE 2 BI-DIR OUT) of Probe PCB and connect to Common of external power supply.

Step 7: Set external power supply for +30 VDC (verify with DMM).

Step 8: Verify Power Loop Current of 417A-2 Meter with DMM. Do this by adjusting 417A-2 CURRENT ADJUST pot on front panel from 30 mA through 140 mA range span while using DMM to measure external power supply current. The DMM and 417A-2 Meter should agree in value ±5 mA throughout the current range span. If not, adjust 417A-2 A4 Board R7 so that 417A-2 Meter value equals DMM value.

Step 9: Set external power supply for +300 VDC and verify DMM and 417A-2 Meter current values agree within ±5 mA throughout the current range span.

Step 10: Reverse polarity of external power supply leads and set 417A-2 METER switch to OFFICE A REV and verify with DMM that proper Power Loop current values appear on 417A-2 Meter for external power supply voltages of 30 VDC and 300 VDC. Do this by adjusting 417A-2 CURRENT ADJUST pot from 30 mA through 140 mA range span while using a DMM to measure external power supply current.

Step 11: Set METER switch to OFFICE B mAx10.

Step 12: Set RPTR POWER LOOP switch to FROM OFFICE B and turn CURRENT ADJUST pot full counterclockwise.

Step 13: Remove shorts and power supply from Probe PCB.

Step 14: Short together pins E7 and E8 (SIDE 2 BI-DIR IN) of Probe PCB and connect to + Volts of external power supply.

Step 15: Short together pins E1 and E2 (SIDE 1 OUT) of Probe PCB and connect to Common of external power supply.

Step 16: Set external power supply for +30 VDC.

Step 17: Repeat step 8 and if necessary adjust A4 Board R9 so that meters agree.

Step 18: Set external power supply for +300 VDC and verify DMM and 417A-2 Meter current values agree within ±5 mA throughout the current range span.

Step 19: Reverse polarity of external power supply leads and set 417A-2 METER switch to OFFICE B REV and verify with DMM that proper Power Loop current values appear on 417A-2 Meter for external power supply voltages of 30 VDC and 300 VDC (see step 10).

Step 20: For Repeater Volts verification, return external power supply leads to proper polarity (see steps 14 and 15) and set external power supply for +15 VDC (verify with DMM).

Step 21: Set 417A-2 METER switch to RPTR VOLTS and RPTR POWER LOOP switch to OFF. 417A-2 Meter value should read +15 ±0.5 VDC.

Step 22: For Voltage Overload Relay, slowly turn up external power supply voltage. 417A-2 Meter should cut off to 0 volts when external power supply is between 16 and 17 VDC. This verifies that the overload relay is operating properly.

3. TECHNICAL DATA

SPECIFICATIONS

3.01 Specifications for the Sierra 417A-2 PCM Line and Repeater Test set are given in Table 3-1.

Table 3-1. 417A-2 Test Set Specifications

Parameter	Characteristic
Input Signal	Standard bipolar pulses, as attenuated and deteriorated by cable loss and noise.
Bit Rates	1.544 Mb/s (T1-type) 2.37 Mb/s (T148-type) 3.152 Mb/s (T1C-type)
Input Impedance (Bridging)	5000 ohms nominal
Input Signal Level	Maximum: ±4 V base-to-peak Minimum: (1.544 Mb/s) 36 dB below maximum, at 772 KHz (½ bit rate) (2.37 Mb/s) 42 dB below maximum, at 1.18 MHz (½ bit rate) (3.152 Mb/s) 54 dB below maximum, at 1.58 MHz (½ bit rate)
Meter Accuracy	± 3% of full scale
Power Requirements	8 D-size batteries (carbon-zinc, alkaline)
Power Loop Regulator	15 to 300 Volts
Expected Battery Life	50 hours intermittent 8 hours continuous
Battery Fuse	½ A SLO-BLO
Temperature Range	Operating: 0°C to 60°C without sun loading Non-operating: –40°C to +65°C Maximum Humidity: 95%
Physical Dimensions	Apx. 7½ in. H x 12 in. W x 8¼ in. D (behind front panel).
Weight	Apx. 18 lbs. (including lid, batteries and probe).

ORDERING INFORMATION

3.02 The 417A-2 is supplied with a cloth web shoulder strap. Additional accessories are listed in Table 3-2.

Table 3-2. Accessories

PART NUMBER	APPLICATION
C02699001	Insert - Vicom 1550, ITT, and Similar
C02700502	Insert - Standard T1 (WECo 201/205)
C02979601	Insert - Mini T1 Repeaters (WECo 238/239)
C03147000	Insert - T1C (WECo 248/249)
C03146900	Insert - WECo 217A (Connector Interface for 246A-4)
242B	Probe - Vicom 1550, ITT, and similar (Requires Adapter Cable)
242C	Probe - ITT "T1" and "T148" (Requires Adapter Cable)
243A-4	Patch Cable, 310 Plug to Alligator Clips
244A-1	Probe - T1C (WECo 248/249)
244A-2	Probe - Standard T1 (WECo 201/205)
244A-3	Probe - Mini T1 Repeaters (WECo 238/239)
246A-3	Probe - WECo 217A (SLC 40)
246A-4	Cable Assembly for WECo 217A (Also Requires C03146900)
1417A	Portable Signal Source, T1C
247A-1	Cable Splitting Adapter
C03256000	Adapter Cable (300-Series Probes to 400-Series Sets)
921000075	Canvas Carrying Case (417A-2)

4. SCHEMATICS AND PARTS LISTS

4.01 Following is a list of 417A-2 schematic diagrams and parts lists included in this section.

Drawing Number	Description
D03178800	417A-2 Interconnect Diagram (2 sheets)
D03178300	A1 Termination and Repeater
D03199200	A2 ALBO Regenerator (2 sheets)
D03195200	A2B ALBO Regenerator
D03178500	A3 Error Detector
D03178600	A4 Power Loop and Meter Circuit
D03178700	A5 Mother Board (2 sheets)
D03161400	Front Panel Assembly

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A1	PWB ASSY, A1, 417A-2	D03178300
J1	SOCKET,DIP 16 PIN	914200084
J2	SOCKET,DIP 16 PIN	914200084
J3	SOCKET,DIP 16 PIN	914200084
J4	SOCKET,DIP 16 PIN	914200084
S1	SWITCH, ROTARY 4 POS 1 POLE 10 SEC 30 DEGRE	911200255
S2	SWITCH, ROTARY 5 POS 1 POLE 6 SEC 30 DEGREE	911200256
T1	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
T2	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
T3	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
T4	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
T5	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
T6	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
T7	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A2	PWB ASSY, A2, 417A-2	D03199200
C1	CAPACITOR,TANT 10MF 10% 10V	902750106
C2	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C3	CAPACITOR POLYCARB .0056 MF 2% 50V-100V	903100562
C4	CAPACITOR,TANT 10MF 10% 10V	902750106
C5	CAPACITOR,DIPPED MICA 560PF 5% 300V	901900561
C6	CAPACITOR,MICA,56PF,5%,500V	901900560
C7	CAPACITOR,DIPPED MICA 220PF 5% 50V	901900221
C8	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C9	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C10	CAPACITOR,TANT 10MF 10% 10V	902750106
C11	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C12	CAPACITOR,TANT 10MF 10% 10V	902750106
C13	CAPACITOR,CERAMIC,1000PF,10%,200V	901320102
C14	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C15	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C16	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C17	CAPACITOR,DIPPED MICA 22PF 5% 50CV	901900220
C18	CAPACITOR,DIPPED MICA 75PF 5% 500V	901900750
C19	CAPACITOR,DIPPED MICA 22PF 5% 50CV	901900220
C20	CAPACITOR,DIPPED MICA 330PF 5% 50V	901900331
C21	CAPACITOR,CERAMIC 0.22MF 10% 50V	901330224
C23	CAPACITOR,CER,0.01MF,10%,100V	901320103
C24	CAPACITOR,CER,0.01MF,10%,100V	901320103
C25	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C26	CAPACITOR,CERAMIC,1000PF,10%,200V	901320102
C27	CAPACITOR,TANT 10MF 10% 10V	902750106
C28	CAPACITOR,CERAMIC,1000PF,10%,200V	901320102
C29	CAPACITOR,DIPPED MICA 120PF 5% 500V	901900121
C30	CAPACITOR,DIPPED MICA 120PF 5% 500V	901900121
C31	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C32	CAPACITOR DIPPED MICA 100PF,5%,500V	901900101
C33	CAPACITOR DIPPED MICA 100PF,5%,500V	901900101
C34	CAPACITOR VARIABLE CERAMIC 7-25PF N300	903220250
C35	CAPACITOR,CERAMIC,1000PF,10%,200V	901320102
C36	CAPACITOR,CERAMIC,1000PF,10%,200V	901320102
C37	CAPACITOR,DIPPED MICA 15PF 5% 500V	901900150
C38	CAPACITOR,TANT 10MF 10% 10V	902750106
C39	CAPACITOR,TANT 10MF 10% 10V	902750106
C40	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C41	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C42	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C43	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C44	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C45	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C46	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C47	CAPACITOR,MICA,56PF,5%,500V	901900560
C48	CAPACITOR,MICA,56PF,5%,500V	901900560

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
	A2 PWB ASSY (Continued)	
C49	CAPACITOR,CERAMIC 0.22MF 10% 50V	901330224
C50	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C51	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C53	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C55	CAPACITOR,MICA,56PF,5%,500V	901900560
C56	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
CR1	DIODE SI IN3064 50V 75MA 250MW	910503064
CR2	DIODE SI IN3064 50V 75MA 250MW	910503064
CR3	DIODE SI IN3064 50V 75MA 250MW	910503064
CR5	DIODE SI IN3064 50V 75MA 250MW	910503064
CR6	DIODE SI IN3064 50V 75MA 250MW	910503064
CR7	DIODE SI IN3064 50V 75MA 250MW	910503064
L1	INDUCTOR,FXD MOLDED 180UH 5% .22W	909000142
L2	INDUCTOR,FXD MOLDED, 100UH 5% 0.22W	909000145
L3	INDUCTOR,FXD MOLDED, 100UH 5% 0.22W	909000145
L4	INDUCTOR,FXD MOLDED, 100UH 5% 0.22W	909000145
L5	INDUCTOR,FXD MOLDED, 100UH 5% 0.22W	909000145
Q1	TRANSISTOR,SI,2N3904,NPN	910303904
Q2	TRANSISTOR,SI,2N3904,NPN	910303904
Q3	TRANSISTOR,SI,2N3904,NPN	910303904
Q4	TRANSISTOR,SI,2N3906,PNP	910303906
Q5	TRANSISTOR,SI,2N3906,PNP	910303906
Q6	TRANSISTOR,SI,2N3906,PNP	910303906
R3	RESISTOR COMP 20K OHM 5% 1/4W	906900203
R4	RESISTOR,FXD,COMP,33K OHM 1/4W 5%	906900333
R5	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R6	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R7	RESISTOR,FXD,COMP,2.2K OHM 1/4W 5%	906900222
R8	RESISTOR COMP 390 OHM 5% 1/4W	906900391
R9	RESISTOR COMP 820 OHM 5% 1/4W	906900821
R10	RESISTOR COMP 430 OHM 5% 1/4W	906900431
R11	RESISTOR COMP 820 OHM 5% 1/4W	906900821
R12	RESISTOR,FXD,COMP,5.1K OHM 1/4W 5%	906900512
R13	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R14	RESISTOR COMP 8.25K OHM 1% 1/8W	907308251
R15	RESISTOR,COMP,3.9K OHM,1/4W,5%	906900392
R16	RESISTOR,COMP,3.9K OHM,1/4W,5%	906900392
R17	RESISTOR,COMP,3.9K OHM,1/4W,5%	906900392
R18	RESISTOR,COMP,3.9K OHM,1/4W,5%	906900392
R19	RESISTOR,COMP 910 OHM 1/4W 5%	906900911
R20	RESISTOR,COMP 910 OHM 1/4W 5%	906900911
R21	RESISTOR,FXD,COMP,1.2K OHM 1/4W 5%	906900122
R22	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R23	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R24	RESISTOR COMP 51K OHM 5% 1/4W	906900513
R26	POTENTIOMETER 2K 10% 15 TURN	907900288
R27	RESISTOR,COMP,2K OHM,1/4W,5%	906900202
R28	RESISTOR,COMP,2K OHM,1/4W,5%	906900202
R29	RESISTOR,FXD,COMP,5.1K OHM 1/4W 5%	906900512

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
	A2 PWB ASSY (Continued)	
R30	RESISTOR,FXD,COMP,5.1K OHM 1/4W 5%	906900512
R31	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R32	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R33	RESISTOR COMP 470 OHM 5% 1/4W	906900471
R34	RESISTOR,FXD,COMP,750 OHM 1/4W 5%	906900751
R35	RESISTOR,FXD,COMP,5.1K OHM 1/4W 5%	906900512
R36	RESISTOR COMP 9.1K OHM 5% 1/4W	906900912
R37	RESISTOR COMP 4.3K OHM 5% 1/4W	906900432
R38	RESISTOR,FXD,COMP 120 OHM 1/4W 5%	906900121
R39	RESISTOR,FXD,COMP,1.2K OHM 1/4W 5%	906900122
R40	RESISTOR COMP 6.2K OHM 5% 1/4W	906900622
R41	RESISTOR COMP 20K OHM 5% 1/4W	906900203
R42	RESISTOR COMP 20K OHM 5% 1/4W	906900203
R43	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R44	RESISTOR,FXD,COMP,5.1K OHM 1/4W 5%	906900512
R45	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R46	RESISTOR,FXD,COMP,510 OHM 1/4W 5%	906900511
R47	RESISTOR COMP 18K OHM 5% 1/4W	906900183
R48	RESISTOR COMP 9.1K OHM 5% 1/4W	906900912
R49	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R50	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R51	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R52	RESISTOR COMP 4.3K OHM 5% 1/4W	906900432
R53	RESISTOR COMP 4.3K OHM 5% 1/4W	906900432
R54	RESISTOR COMP 20.0K OHM 1% 1/8W	907302002
R55	RESISTOR COMP 20.0K OHM 1% 1/8W	907302002
R56	RESISTOR COMP 46.4K OHM 1% 1/8W	907304642
R57	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R58	RESISTOR COMP 46.4K OHM 1% 1/8W	907304642
R59	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R60	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R61	RESISTOR,FXD,COMP,33K OHM 1/4W 5%	906900333
R62	RESISTOR,FXD,COMP,33K OHM 1/4W 5%	906900333
R63	RESISTOR,FXD,COMP,4.7K OHM 1/4W 5%	906900472
R64	RESISTOR,FXD,COMP,4.7K OHM 1/4W 5%	906900472
R65	RESISTOR,FXD,COMP,2.2K OHM 1/4W 5%	906900222
R66	RESISTOR,COMP 4.7M OHM 5% 1/4W	906900475
R67	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R68	RESISTOR,COMP 16K OHM 5% 1/4W	906900163
R69	RESISTOR,COMP,10 MEG OHM,5% 1/4W	906900106
R70	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R71	RESISTOR COMP 24K OHM 5% 1/4W	906900243
R72	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R73	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R74	POT, 1.0K OHMS 1W	907900377
R75	RESISTOR COMP 33 OHM 5% 1/4W	906900330
R76	RESISTOR,FXD,COMP,4.7K OHM 1/4W 5%	906900472
R77	POT,10K,10%,15 TURN	907900281

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
	A2 PWB ASSY (Continued)	
R78	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R79	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R80	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R81	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R83	RESISTOR COMP 18K OHM 5% 1/4W	906900183
R84	RESISTOR,FXD,COMP,5.1K OHM 1/4W 5%	906900512
R85	RESISTOR,FXD,COMP,510 OHM 1/4W 5%	906900511
R86	RESISTOR COMP 470 OHM 5% 1/4W	906900471
R87	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R90	POT,20K 1/2W 10%	907900331
T1	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
U1	IC,NE592A,WIDE BAND VIDEO AMP	920300592
U2	IC,NE592A,WIDE BAND VIDEO AMP	920300592
U3	IC,LM324N,QUAD OPERATIONAL AMP	920300324
U4	IC,MC1596L,MODULATOR-DEMODULATOR	920301596
U5	IC,LM319N,DUAL COMPARATOR,HIGH SPEED	920300319
U6	IC,CA3096AE,NPN/PNP TRANSISTOR ARRAY	920303096
U7	IC,XR-S200,MULTI-FUNCTION MET CER PKG	920300200
U8	IC,CD4049BE,HEX BUFFER/CONVERTER	920204049
U9	IC,MC14013BCP,CMOS DUAL D-TYPE FLIP-FLOP	920204013
U10	IC,CA3019,DIODE ARRAY LINEAR	920303019
U11	IC,CD4052BE,4 CHANNEL MULTIPLEXER	920204052
VR1	DIODE,ZENER,1N5235	910655235

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A2B	PWB ASSY, A2B, 417A-2	D03195200
C1	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C2	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C3	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C4	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C5	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C6	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C7	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C8	CAPACITOR,DIPPED MICA 220PF 5% 50V	901900221
C9	CAPACITOR,CERAMIC 0.47MF,20%,50V	901300474
C10	CAPACITOR,CERAMIC 0.1MF,20%,50V	901300104
C11	CAPACITOR,CERAMIC 0.1MF,20%,50V	901300104
C12	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C13	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C14	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
CR1	DIODE SI IN3064 50V 75MA 250MW	910503064
CR2	DIODE SI IN3064 50V 75MA 250MW	910503064
CR3	DIODE SI IN3064 50V 75MA 250MW	910503064
CR4	DIODE SI IN3064 50V 75MA 250MW	910503064
Q1	TRANSISTOR,SI,2N3904,NPN	910303904
R1	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R2	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R3	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R4	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R5	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R6	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R7	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R8	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R9	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R10	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R11	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R12	RESISTOR,FXD,COMP,2.2K OHM 1/4W 5%	906900222
R13	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R14	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R15	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R16	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R17	RESISTOR,FXD,COMP,3K OHM 1/4W 5%	906900302
R18	RESISTOR COMP 6.8K OHM 5% 1/4W	906900682
R19	RESISTOR,FXD,COMP,510 OHM 1/4W 5%	906900511
R20	RESISTOR COMP 2.4K OHM 5% 1/4W	906900242
R21	RESISTOR COMP 2.4K OHM 5% 1/4W	906900242
R22	POTENTIOMETER 1K 10% 15 TURN PC MTG	907900290
R23	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R24	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R25	RESISTOR COMP 390 OHM 5% 1/4W	906900391
R26	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R27	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R28	RESISTOR COMP 68K OHM 5% 1/4W	906900683
R29	RESISTOR COMP,10K OHM,1/4W,5%	906900103

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
	A2B PWB ASSY (Continued)	
R30	PCT,20K 1/2W 10%	907900331
R31	RESISTOR COMP 24K OHM 5% 1/4W	906900243
R32	RESISTOR,FXD,COMP,15K OHM 1/4W 5%	906900153
R33	RESISTOR COMP 2.2 MEG OHM 5% 1/4W	906900225
R34	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R35	RESISTOR COMP 56 OHM 5% 1/4W	906900560
R36	RESISTOR COMP 10.0 OHM 5% 1/4W	906900100
T1	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
TP1	JACK,TEST 90 PC MTG, BLACK	915200032
TP2	JACK TEST 90 P C MTG GRAY	915200023
U1	IC,MC1596L,MODULATOR-DEMODULATOR	920301596
U2	IC,MC1596L,MODULATOR-DEMODULATOR	920301596
U3	IC,LM339N,QUAD VOLTAGE COMPARATOR	920300339
VR1	DIODE ZENER IN5225B 3.0V 5% 500MW	910635225

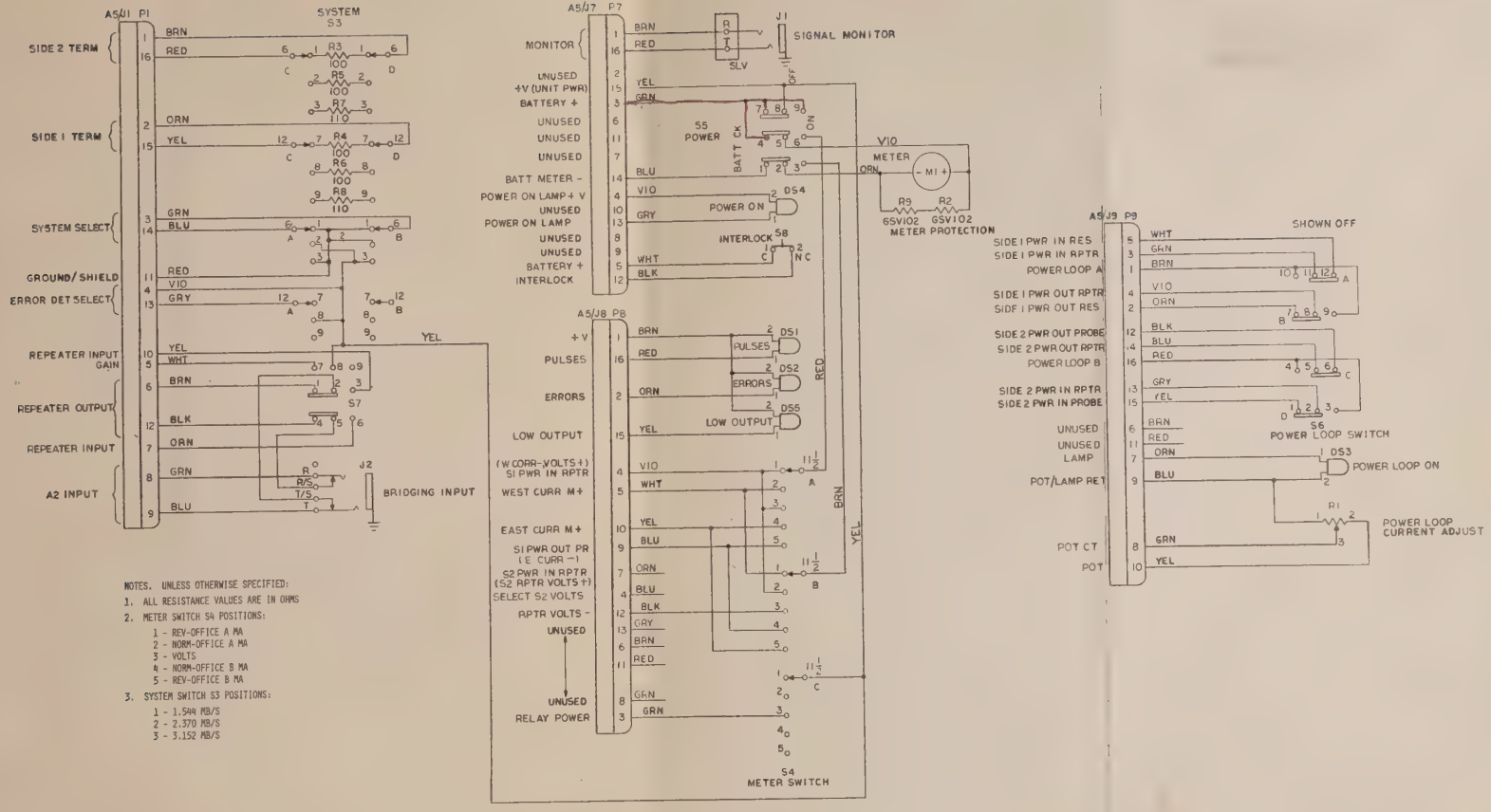
REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A3	PWB ASSY, A3, 417A-2	D03178500
C1	CAPACITOR,RADIAL LEADS 0.1MF,10%,100V	901330104
C2	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C3	CAPACITOR,DIPPED TANTLEX 10MF 20% 20VDC	902710106
C4	CAPACITOR,SOLID TANT, 2.2MF 10% 20V	902710225
C5	CAPACITOR,SOLID TANT, 2.2MF 10% 20V	902710225
C6	CAPACITOR,RADIAL LEADS 0.1MF,10%,100V	901330104
Q1	TRANSISTOR,SI,2N3906,PNP	910303906
Q2	TRANSISTOR,SI,2N3906,PNP	910303906
Q3	TRANSISTOR,SI,2N3906,PNP	910303906
R1	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R2	RESISTOR,FXD,COMP,130K OHM 1/4W 5%	906900134
R3	RESISTOR COMP 82K OHM 5% 1/4W	906900823
R4	RESISTOR,COMP 36K OHM 1/4W 5%	906900363
R5	RESISTOR,FXD,COMP,220K OHM 1/4W 5%	906900224
R6	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R7	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R8	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R9	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R10	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R11	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R12	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R13	RESISTOR COMP 470K OHM 5% 1/4W	906900474
R14	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R15	RESISTOR,FXD,COMP 1K OHM 1/4W 5%	906900102
R16	RESISTOR,FXD,COMP 120 OHM 1/4W 5%	906900121
R17	RESISTOR,FXD,COMP 120 OHM 1/4W 5%	906900121
R18	RESISTOR COMP 300 OHM 5% 1/4W	906900301
R19	RESISTOR COMP 300 OHM 5% 1/4W	906900301
R20	RESISTOR COMP 200 OHM 5% 1/4W	906900201
R23	RESISTOR COMP 2.4K OHM 5% 1/4W	906900242
R24	RESISTOR COMP 9.1K OHM 5% 1/4W	906900912
R25	RESISTOR,COMP 91K OHM 1/4W 5%	906900913
T1	TRANSFORMER TOROIDAL 6MH 20% CTI TO ICT	909300013
U1	IC,MC14013BCP,CMOS DUAL D-TYPE FLIP-FLOP	920204013
U2	IC,CD4030BE,QUAD EXCLUSIVE OR GATE	920204030
U3	IC,CD4000BE,DUAL 3 INPUT NOR GATE	920204000
U4	IC,MC14013BCP,CMOS DUAL D-TYPE FLIP-FLOP	920204013
U5	IC,CD4011BE,CMOS QUAD 2 INPUT NAND GATE	920204011
U6	IC,CD4012BE,DUAL 4 INPUT NAND GATE	920204012
U7	IC,CD4011BE,CMOS QUAD 2 INPUT NAND GATE	920204011
U8	IC,MC14516B,BINARY UP/DOWN COUNTER	920214516
U9	IC,CD4001BE,QUAD 2 INPUT NOR GATE	920204001
U10	IC,CD4007BE,DUAL COMP PAIR & INVERTER	920204007
U11	IC,MC14013BCP,CMOS DUAL D-TYPE FLIP-FLOP	920204013
U12	IC,CD4052BE,4 CHANNEL MULTIPLEXER	920204052
U13	IC,CD4001BE,QUAD 2 INPUT NOR GATE	920204001
U14	IC,CD4049BE,HEX BUFFER/CONVERTER	920204049
VR1	DIODE ZENER IN959B 8.2V 5% 400MW	910630959
VR2	DIODE ZENER IN959B 8.2V 5% 400MW	910630959
VR3	DIODE ZENER IN752A 5.6V 5% 400MW	910630752

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A4	PWB ASSY, A4, 417A-2	D03178600
C1	CAPACITOR,CER,0.1MF,10%,100V	901320103
CR1	RECTIFIER BRIDGE,1.5A 400PRV	910800017
CR2	DIODE,SI,IN4148,75V,150MA,500MW	910504148
CR3	DIODE,SI,IN4148,75V,150MA,500MW	910504148
CR4	DIODE,SI,IN4148,75V,150MA,500MW	910504148
CR5	DIODE,SI,IN4148,75V,150MA,500MW	910504148
CR6	DIODE,SI,IN4148,75V,150MA,500MW	910504148
CR7	DIODE,SI,IN4148,75V,150MA,500MW	910504148
CR8	DIODE,SI,IN4148,75V,150MA,500MW	910504148
J1	CONNECTOR,PC MTG WAFER ASSY POLARIZING	914800203
K1	RELAY,DPDT 9V 1A	912600068
P1	CONNECTOR RECEPTACLE SHELL 8 PIN NYLON	914800202
Q1	TRANSISTOR,SI,2N3904,NPN	910303904
Q2	TRANSISTOR,SI,2N6343,NPN	910303643
Q3	TRANSISTOR,SI,2N3904,NPN	910303904
Q4	TRANSISTOR,2N3439	910303439
Q5	TRANSISTOR, SI, MJ423, NPN HIGH VOLTAGE	910300423
Q6	TRANSISTOR,SI,2N5240,NPN	910305240
Q7	TRANSISTOR,SI,2N5240,NPN	910305240
Q8	TRANSISTOR,SI,2N3904,NPN	910303904
R1	RESISTOR COMP 6.8K OHM 5% 1/4W	906900682
R2	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R3	RESISTOR,FXD,COMP,24 OHM 1/4W 5%	906900240
R4	RESISTOR,COMP,2K OHM,1/4W,5%	906900202
R5	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R6	RESISTOR,MET FILM 2.87 OHM 1W 1%	907602R87
R7	POTENTIOMETER 200 OHM 10% 15 TURN	907900278
R8	RESISTOR,MET FILM 2.87 OHM 1W 1%	907602R87
R9	POTENTIOMETER 200 OHM 10% 15 TURN	907900278
R10	POT,10K,10%,15 TURN	907900281
R11	RESISTOR,FXD,COMP,22K OHM 1/4W 5%	906900223
R14	POT,5K,10%,15 TURN	907900316
R15	RESISTOR,COMP 22K OHM 1W 5%	905400223
R16	RESISTOR COMP 100K OHMS 5% 1/2W	905000104
R17	RESISTOR COMP 100K OHMS 5% 1/2W	905000104
R18	RESISTOR COMP 43K OHM 5% 1/4W	906900433
R19	RESISTOR COMP 820K OHM 5% 1/4W	906900824
R20	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R21	RESISTOR COMP,10K OHM,1/4W,5%	906900103
R22	RESISTOR,COMP 68 OHM 5% 1/2W	905000680
R23	RESISTOR COMP 62 OHM 5% 1/2W	905000620
R24	RESISTOR,FXD,COMP,2.2K OHM 1/4W 5%	906900222
R25	RESISTOR,FXD,COMP 100K OHM 1/4W 5%	906900104
R26	RESISTOR WW 12K OHM 5% 12W	906400123
R27	RESISTOR COMP,10K OHM,1/4W,5%	906900103
S1	SWITCH THERMAL SENSOR GROUP 2	913700005
TP1	JACK TEST 90 P C MTG BROWN	915200030
TP2	JACK TEST 90 P C MTG RED	915200029
TP3	JACK TEST 90 P C MTG ORANGE	915200028

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
	A4 PWB ASSY (Continued)	
TP4	JACK TEST 90 P C MTG YELLOW	915200027
TP5	JACK TEST 90 P C MTG GREEN	915200026
TP6	JACK TEST 90 P C MTG BLUE	915200025
TP7	JACK TEST 90 P C MTG VIOLET	915200024
U1	IC,LM324N,QUAD OPERATIONAL AMP	920300324
VR1	DIODE ZENER IN753A 6.2V 5% 400MW	910630753
VR2	DIODE,ZENER,1N751A,5.1V,5% 400MW	910630751

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A5	PWB ASSY, A5, 417A-2	D03178700
J1	SOCKET,DIP 16 PIN	914200084
J2	CONNECTOR,DIP SOLDER PWB 22/44	914800170
J3	CONNECTOR,DIP SOLDER PWB 22/44	914800170
J4	CONNECTOR,DIP SOLDER PWB 22/44	914800170
J5	CABLE ASSY,FLAT DOUBLE ENDED	916400062
J6	CABLE ASSY,FLAT DOUBLE ENDED	916400062
J7	SOCKET,DIP 16 PIN	914200084
J8	SOCKET,DIP 16 PIN	914200084
J9	SOCKET,DIP 16 PIN	914200084
J10	CONNECTOR,WAFER 2 PIN	914800242
J11	CONNECTOR,DIP SOLDER PWB 22/44	914800170

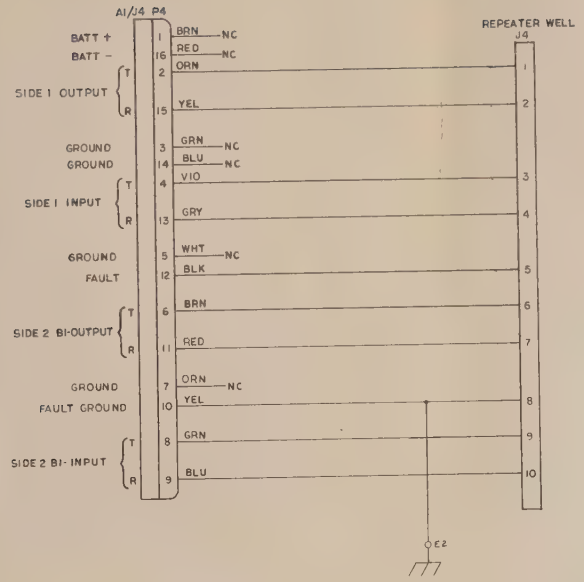
REF DESIG	DESCRIPTION	SIERRA PART NUMBER
FP	ASSY, FRONT PANEL, 417A-2	D03161400
DS1	LAMP,INCANDESCENT,TRANSLUCENT WHITE LENS	913800074
DS2	LAMP,TRANSLUCENT RED LENS	913800072
DS3	LAMP,INCANDESCENT,TRANSLUCENT GREEN LENS	913800073
DS4	LAMP,INCANDESCENT,TRANSLUCENT GREEN LENS	913800073
DS5	LAMP,INCANDESCENT,TRANSLUCENT GREEN LENS	913800073
FP16	LAMP, INCANDESCENT TI FLANGE BASE	913800060
J1	JACK,PHONE 310	914400024
J2	JACK,PHONE 310	914400024
M1	METER,2.500 BEZEL MTG 1.0 MA	911800158
R1	POT,CERMET SINGLE TURN, 5K	907900373
R2	VARISTOR, .74-.90 VOLTS AT 100MA	913600026
R9	VARISTOR, .74-.90 VOLTS AT 100MA	913600026
S5	SWITCH,TOGGLE,3PDT 5A 120VAC/28VDC	911000074
S6	SWITCH,TOGGLE, 4P3T	911000083
S7	SWITCH,TOGGLE,3PDT,5AMP,120VAC/28VDC	911000069
S8	SWITCH,PUSHBUTTON,SPDT,STEEL,PLUNGER	911300060
S3	Switch : system mb PART # 9112005254	B03/6/800
S4	Switch : Meter Part # 9	



NOTES. UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS
2. METER SWITCH S4 POSITIONS:
   - 1 - REV-OFFICE A MA
   - 2 - NORM-OFFICE A MA
   - 3 - VOLTS
   - 4 - NORM-OFFICE B MA
   - 5 - REV-OFFICE B MA
3. SYSTEM SWITCH S3 POSITIONS:
   - 1 - 1.544 MB/S
   - 2 - 2.370 MB/S
   - 3 - 3.152 MB/S

Figure 9-1 (Sheet 1 of 2)
Interconnect Diagram, PCM Line and Repeater Test Set



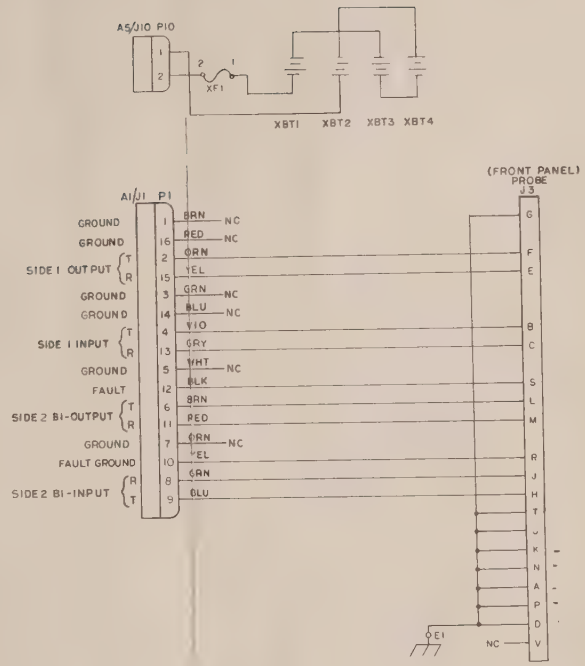
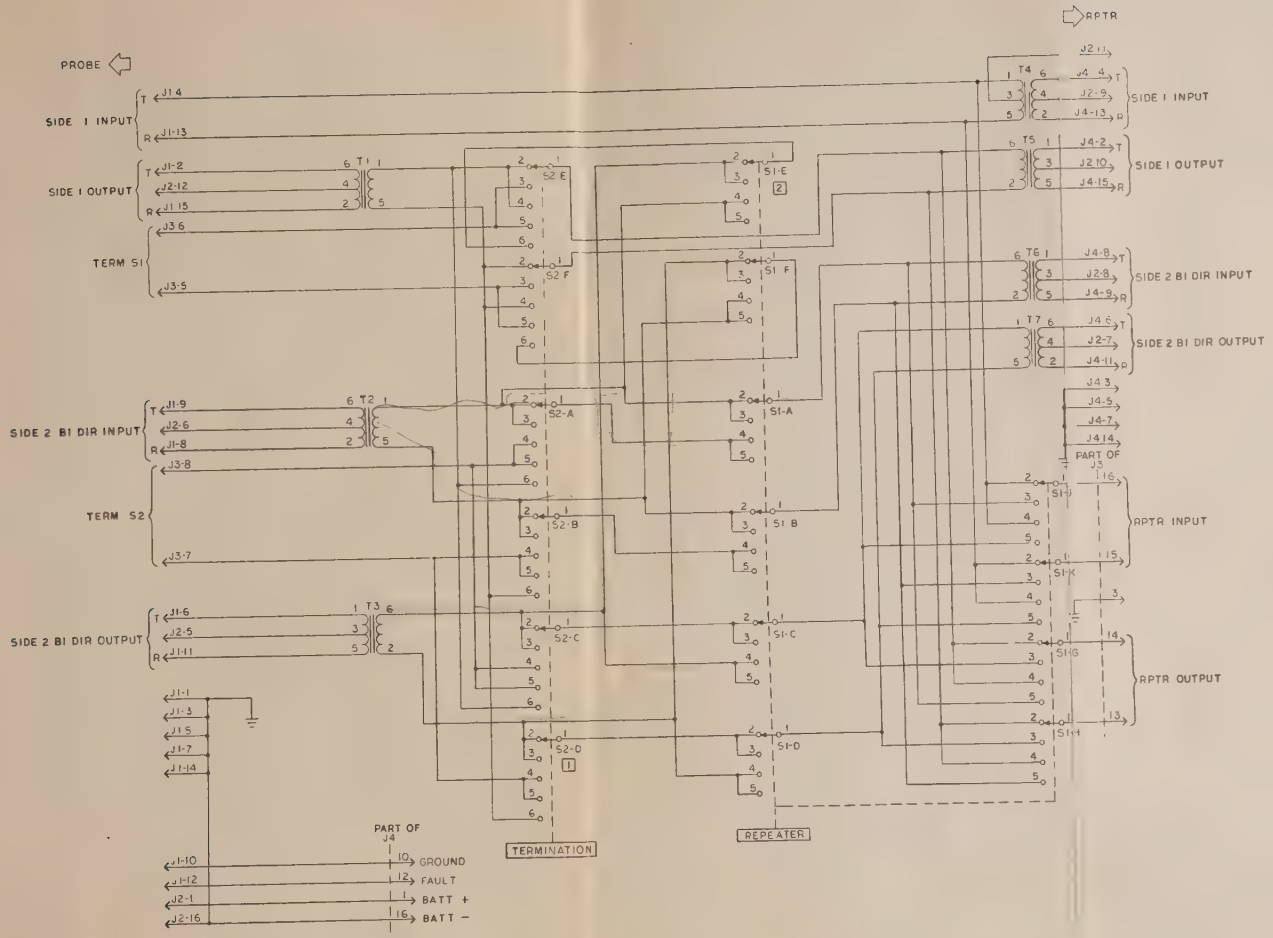


Figure 9-1 (Sheet 2 of 2)
Interconnect Diagram, PCM Line and Repeater Test Set

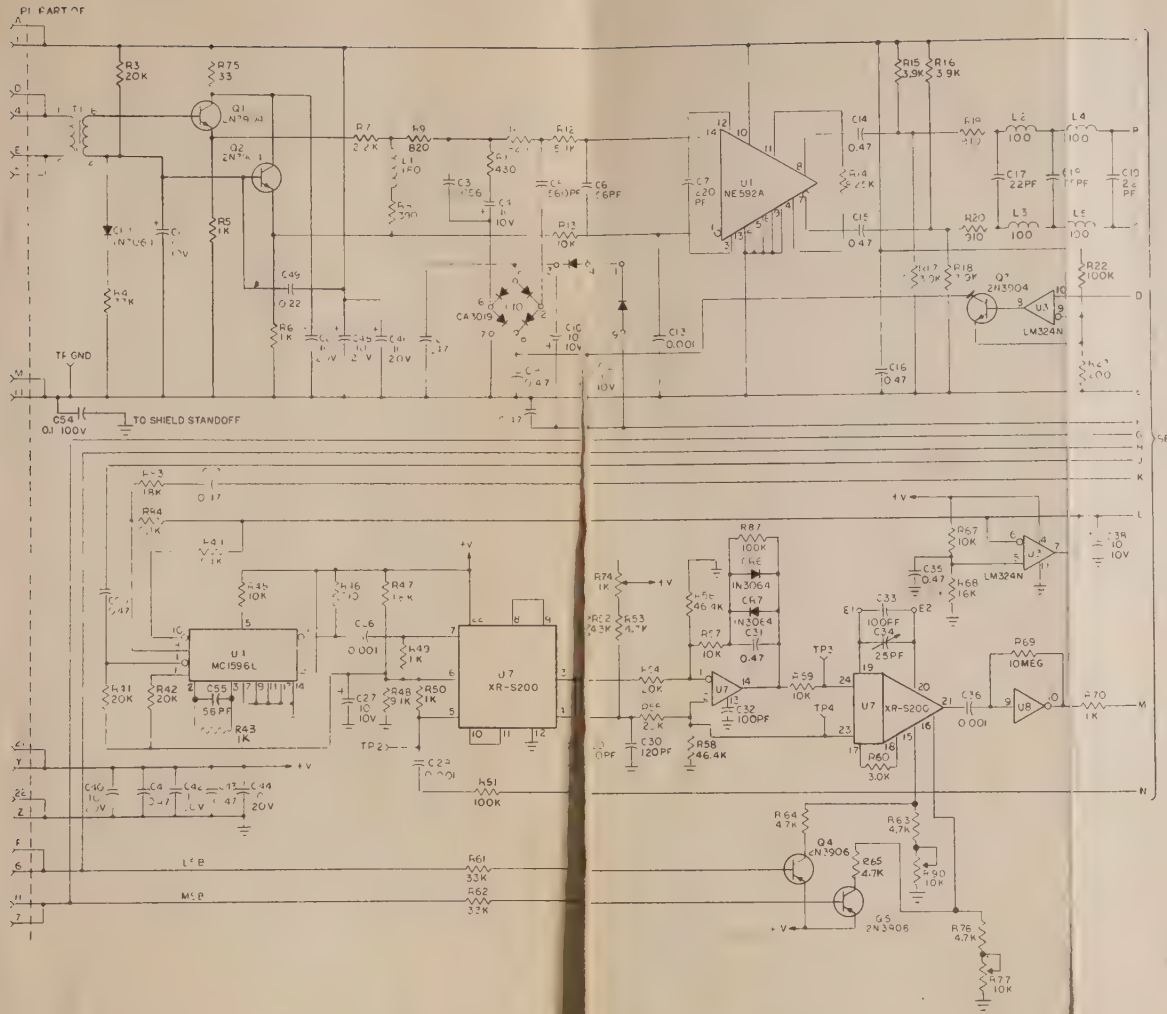


NOTES. UNLESS OTHERWISE SPECIFIED:

[1] S2 SWITCH POSITIONS ARE:
- 2 - NORMAL
- 3 - TERM S1
- 4 - TERM S2
- 5 - BOTH
- 6 - LOOP/FROG

[2] S1 SWITCH POSITIONS ARE:
- 2 - BI-SIDE 1
- 3 - BI-SIDE 2
- 4 - UNI-SIDE 1
- 5 - UNI-SIDE 2

Figure 9-2
Schematic Diagram, A1 Termination and Repeater



NOTES. UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS
3 OPERATING FREQUENCY:

MSB	LSB	FREQUENCY
0	0	1.544M
0	1	2.370M
1	0	3.152M

4. IC V_{DD} AND GROUND CONNECTIONS:

REF. DESIG.	V_{DD}	GND
U8 CD4049AE	1	8
U9 CD4013AE	14	7

Figure 9-3 (Sheet 1 of 2)
Schematic Diagram, A2 ALBO Regenerator

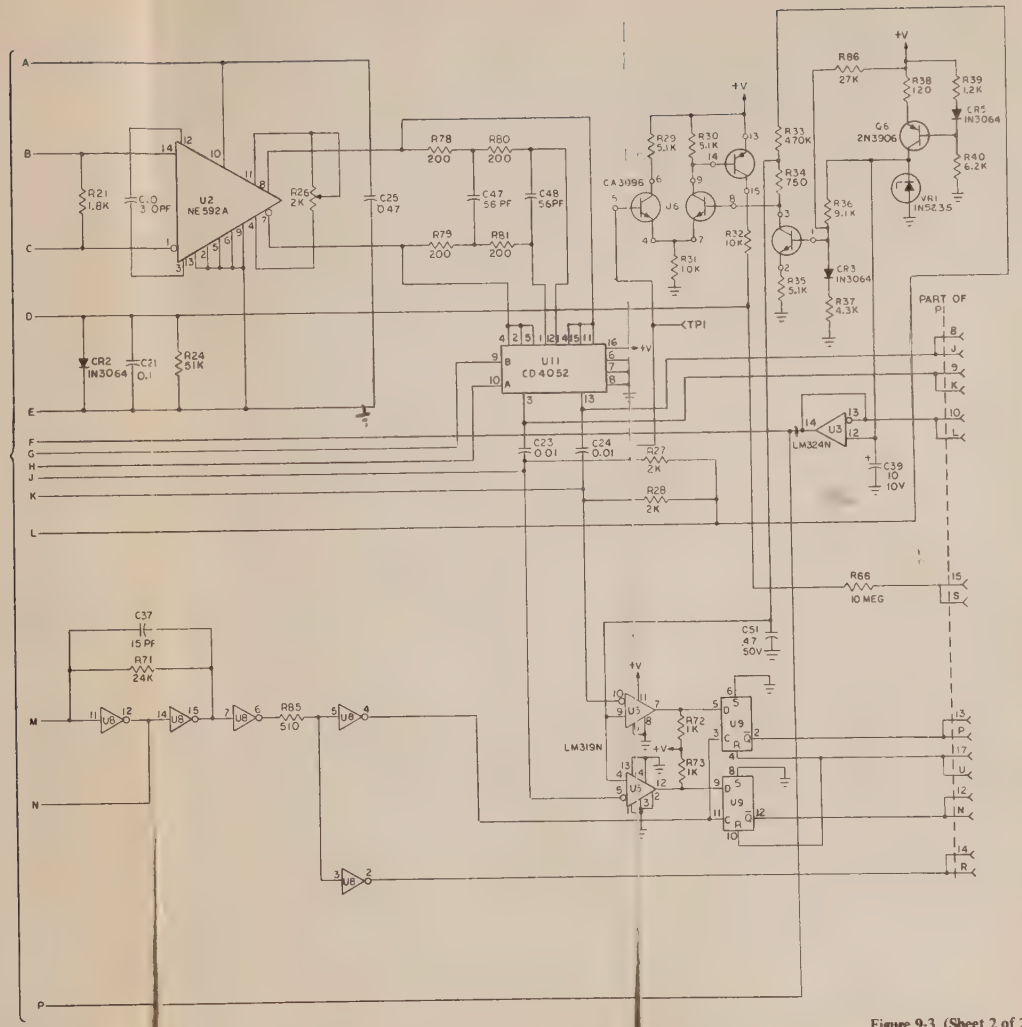


Figure 9-3 (Sheet 2 of 2)
Schematic Diagram, A2 ALBO Regenerator

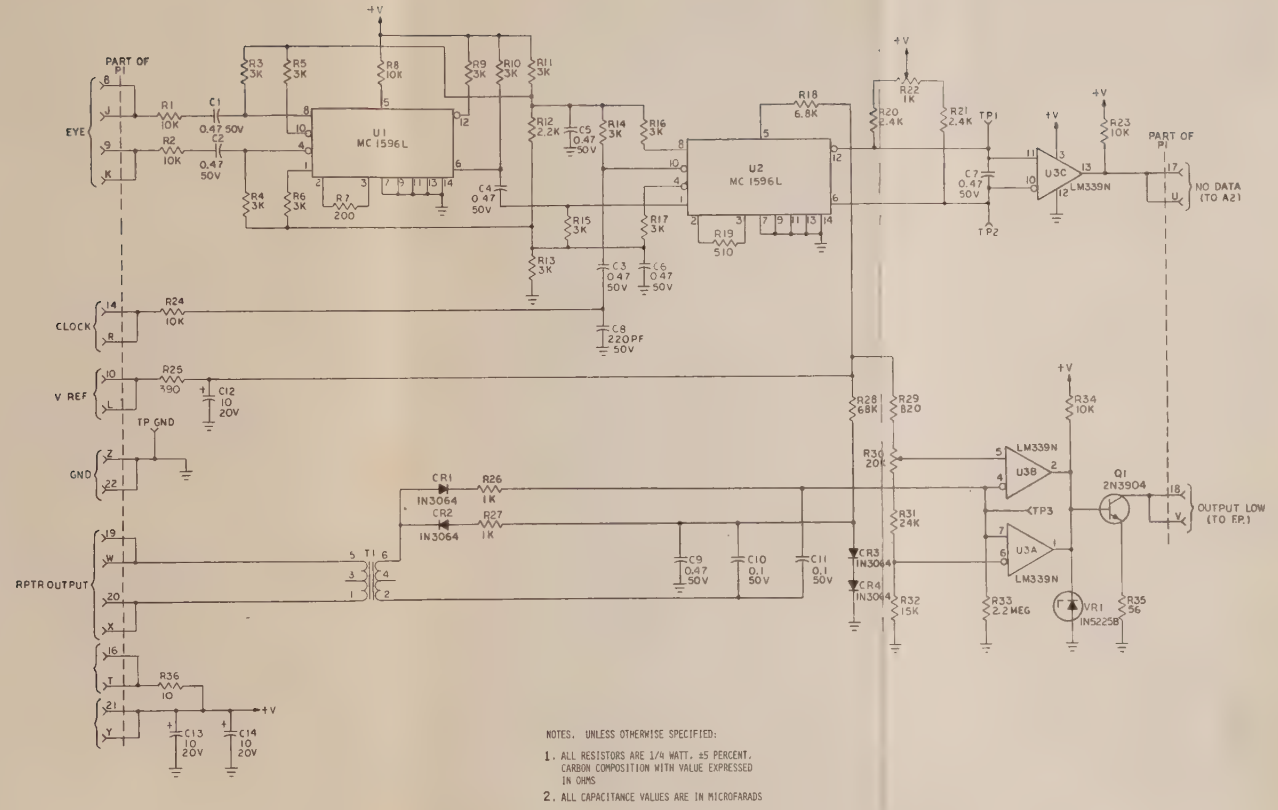
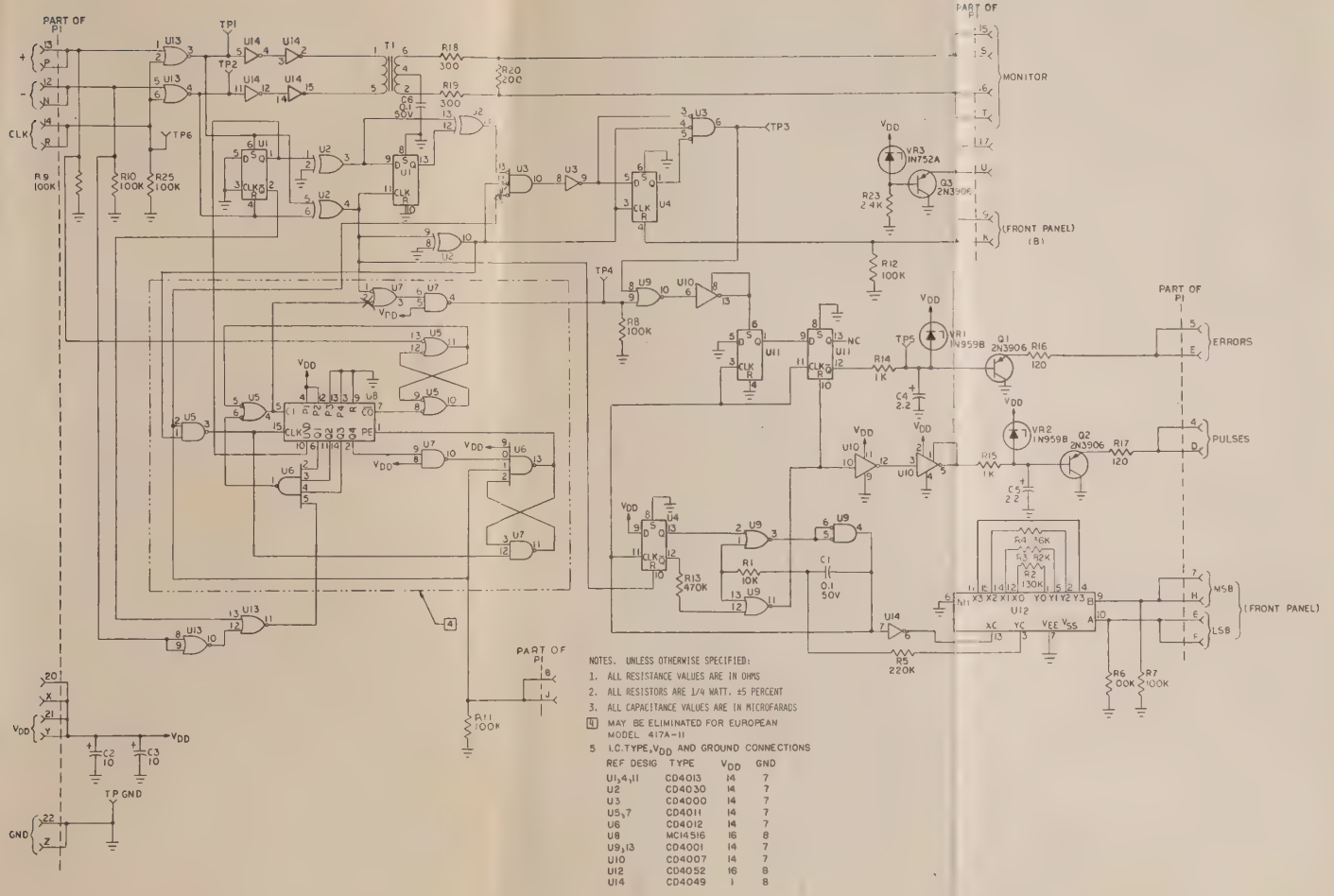


Figure 9-4
Schematic Diagram, A2B ALBO Regenerator

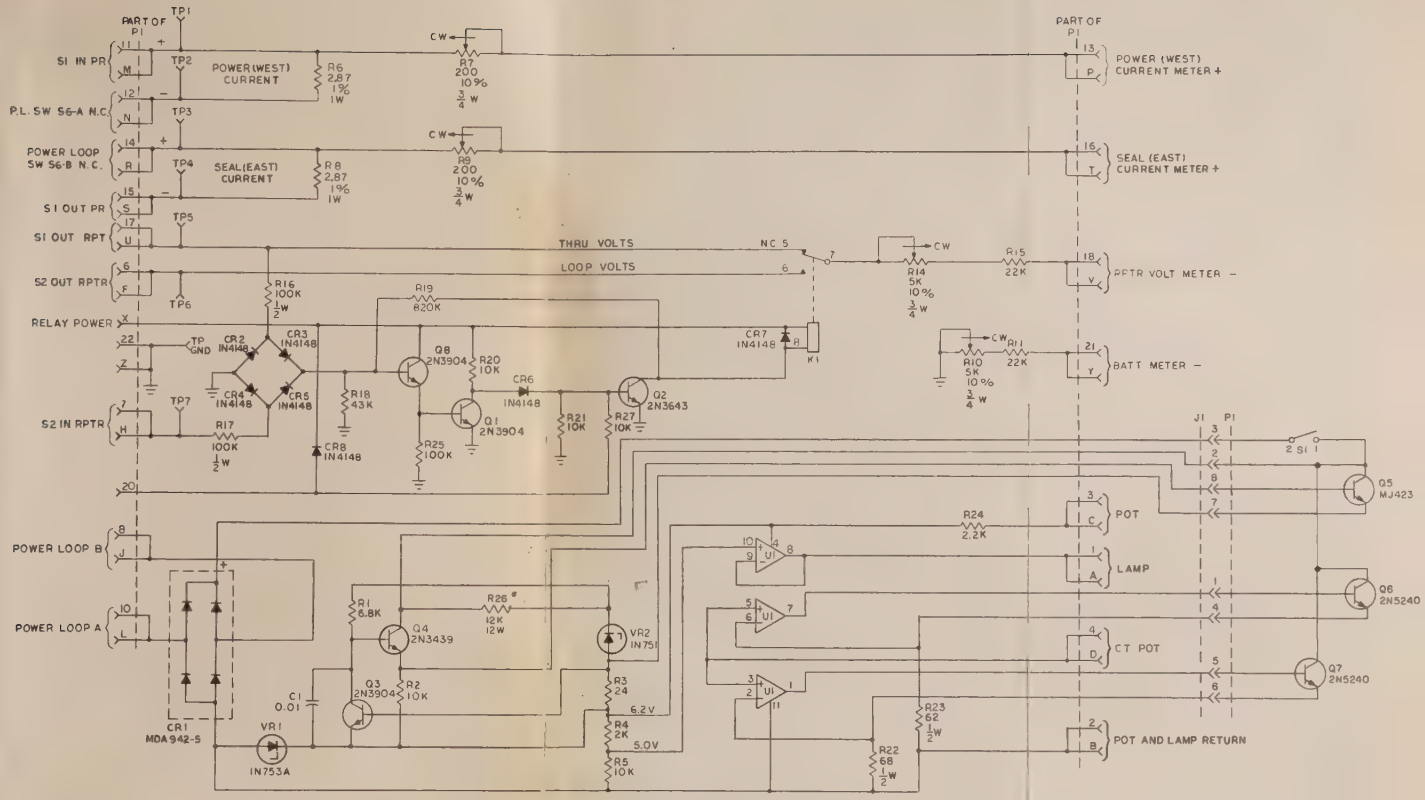


NOTES. UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL RESISTORS ARE 1/4 WATT, ±5 PERCENT
3. ALL CAPACITANCE VALUES ARE IN MICROFARADS
4. MAY BE ELIMINATED FOR EUROPEAN MODEL 417A-11
5. I.C. TYPE, V_{DD} AND GROUND CONNECTIONS

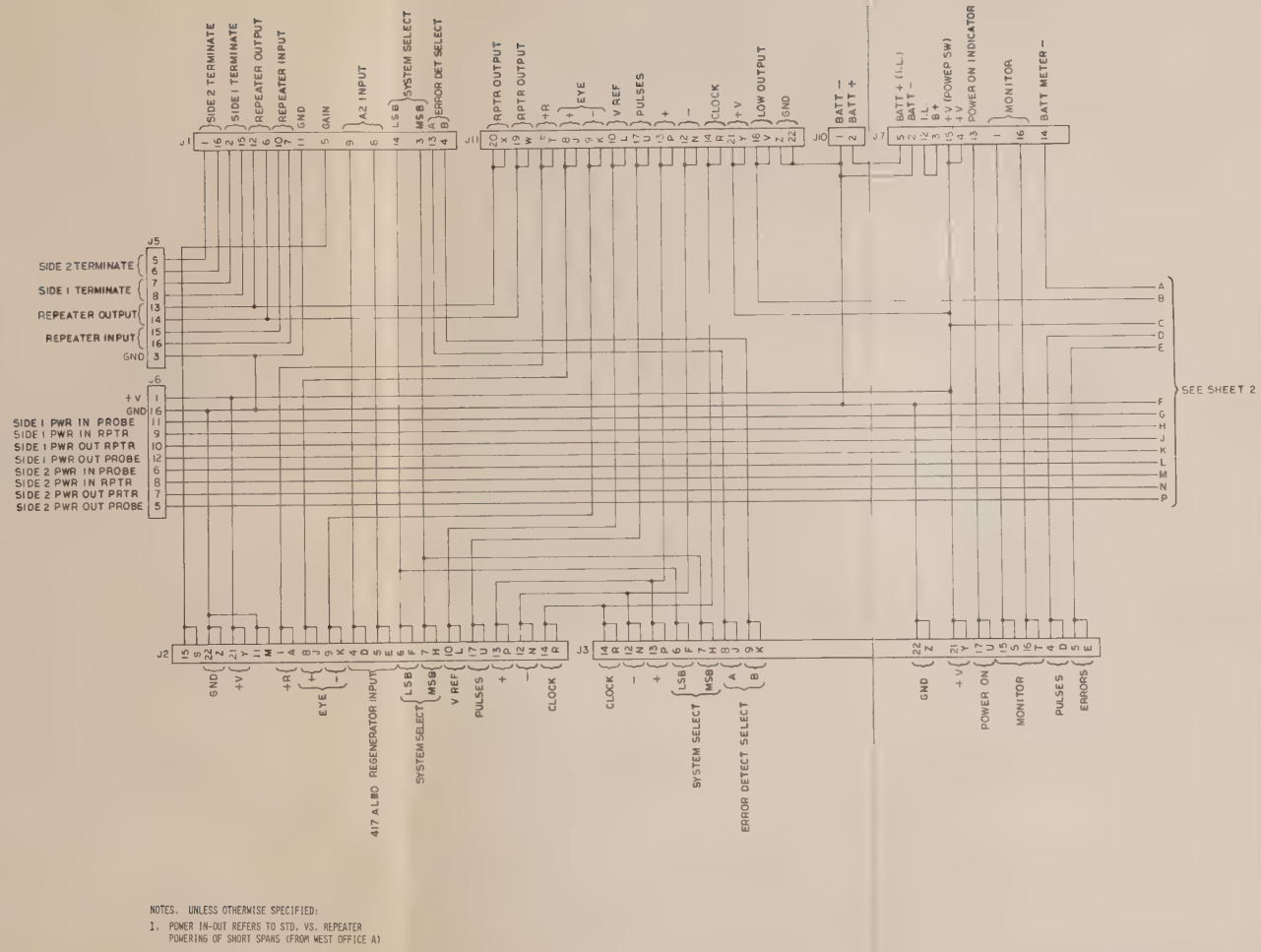
REF DESIG	TYPE	V_{DD}	GND
U1,4,11	CD4013	14	7
U2	CD4030	14	7
U3	CD4000	14	7
U5,7	CD4011	14	7
U6	CD4012	14	7
U8	MC14516	16	8
U9,13	CD4001	14	7
U10	CD4007	14	7
U12	CD4052	16	8
U14	CD4049	1	8

Figure 9-5
Schematic Diagram, A3 Error Detector



NOTES. UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES ARE IN OHMS
2 TRANSISTORS Q5-Q7 ON SEPARATE HEAT SINK
3. ALL CAPACITANCE VALUES ARE IN MICROFARADS

Figure 9-6
Schematic Diagram, A4 Power Loop and Meter Circuit



NOTES. UNLESS OTHERWISE SPECIFIED:

1. POWER IN-OUT REFERS TO STD. VS. REPEATER POWERING OF SHORT SPANS (FROM WEST OFFICE A)

Figure 9-7 (Sheet 1 of 2)
Schematic Diagram, A5 Mother Board

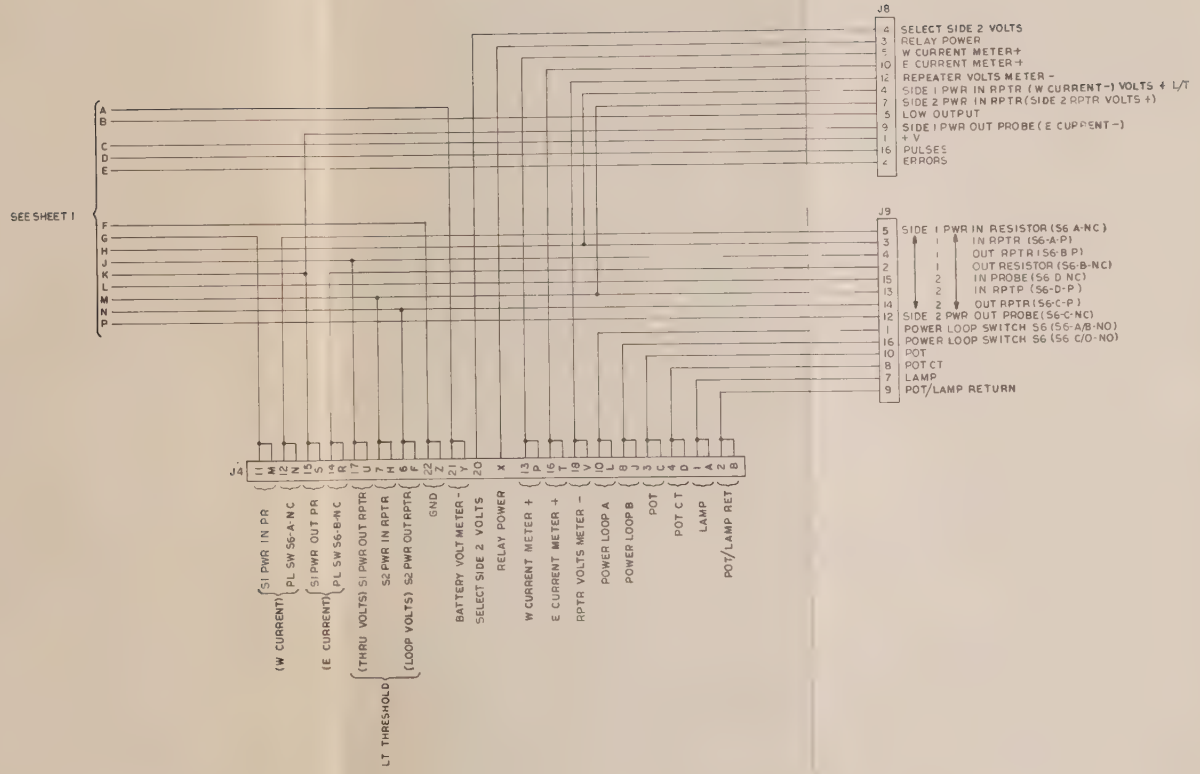


Figure 9-7 (Sheet 2 of 2)
Schematic Diagram, A5 Mother Board

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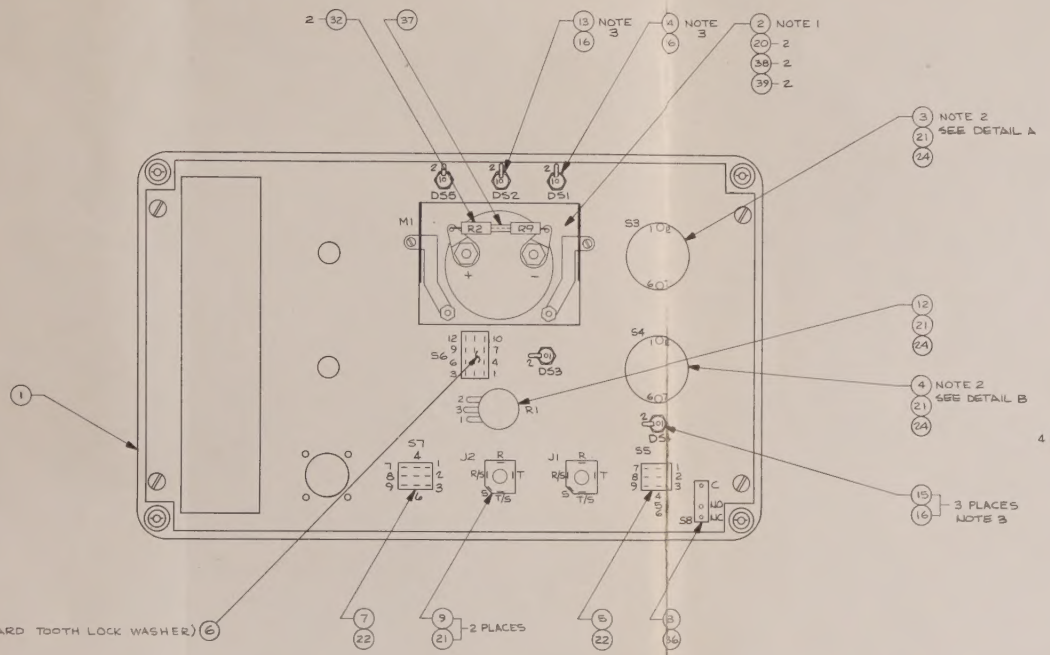
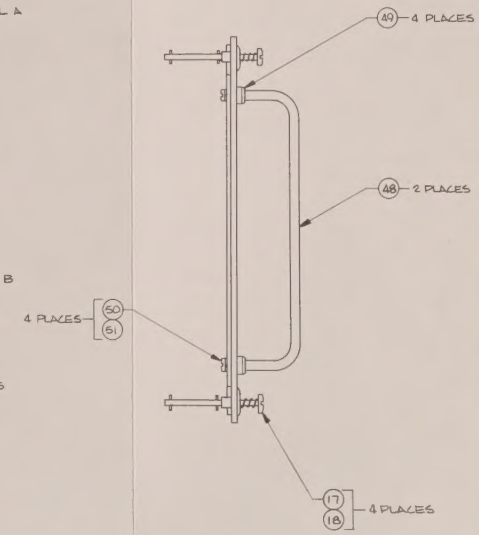
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	PILOT RUN RELEASE	9/9/75	Paull
	AB	PCO 708, 776, 967, 1219, 1161, 1037, 1436		
	B	PRE-PRODUCTION RELEASE	3/1/76	Paull
	B3	PCO 1767, 1796, 1813	11/9/76	MLD
	B4	PCO 2111	4/5/77	
	C	PRODUCTION RELEASE	4/4/77	Paull
	D	ECO 16810 DCW	1/31/78	
	D1	ECO 16833 D.B.	2/17/78	
	E	ECO 16899 D.B.	3/27/78	
	F	ECO 16980 TC	7/7/78	





SEE A03217400 FOR L/M

NOTES:

1. APPLY VCB TO SET SCREWS PRIOR TO ASSEMBLY.
2. SOLDER LUG NUMBERING: CCW
   1, 1½, 2, 2½, ... 6, 7, 7½, ... 12.
   NOT ALL LUGS WILL APPEAR ON SWITCH.
3. SOLDER WIRES TO LAMPHOLDERS PRIOR TO INSTALLING LAMPS.

QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
						LIST OF MATERIAL OR PARTS LIST		
00	REF				A03217400	417A-2		
ASSY. OR ITEM		QTY. NEXT		NEXT ASSY.		MODEL NO.		
					APPLICATION			

ALL THREADS UNIFIED SERIES, EXTERNAL THREADS TO BE CLASS 3A, INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED

√ FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED. REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DWG.

DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.

TOLERANCE UNLESS SPECIFIED

BASIC	TWO PLACE	THREE PLACE
UP TO 6	± .02	±
6 TO 24	± .03	±
ABOVE 24	± .06	±
ANGULAR DIMENSION	±	

FINISH:

Sierra

LEAR SIEGLER, INC. SIERRA ELECTRONIC DIVISION MENLO PARK, CALIFORNIA 94025

CODE IDENT. NO. 94668

FRONT PANEL ASSY

DATE	SIZE	DRAWING NO.	REV.
7/1/76	D	D03161400	F
BY BNJ 6-29-76			
CHECKED			
APPR	SCALE 1/1	STOCK AS ~	SHEET 1 OF 6

DWG. NO. D03161400

7.1
12.9
22.9
34.5
44.3
47.2
51.4
54.3
60.1

LEAR SIEGLER, INC.
SIERRA ELECTRONIC DIVISION
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TWX 910-373-1282

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